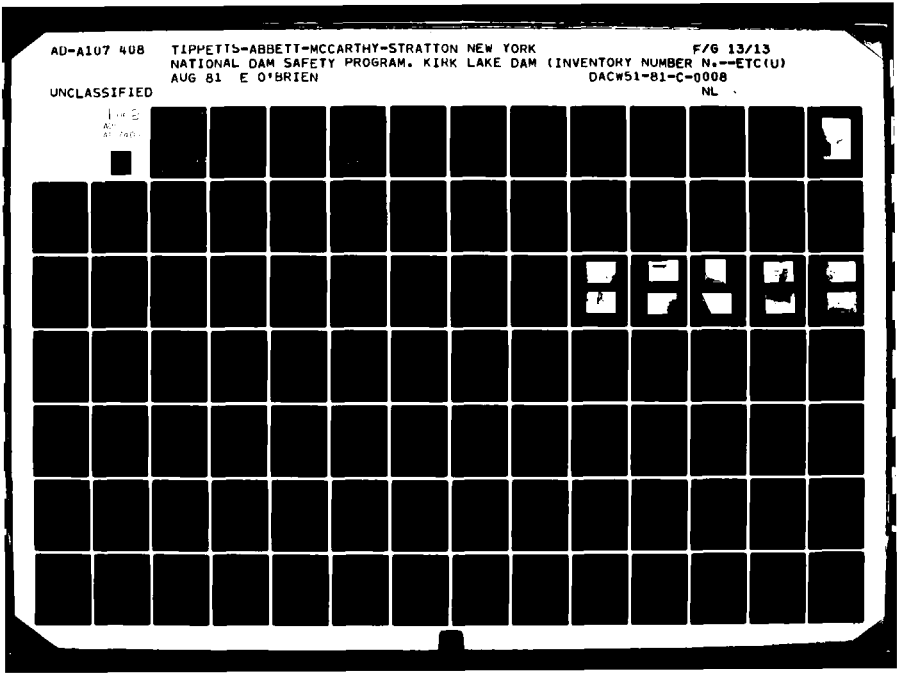
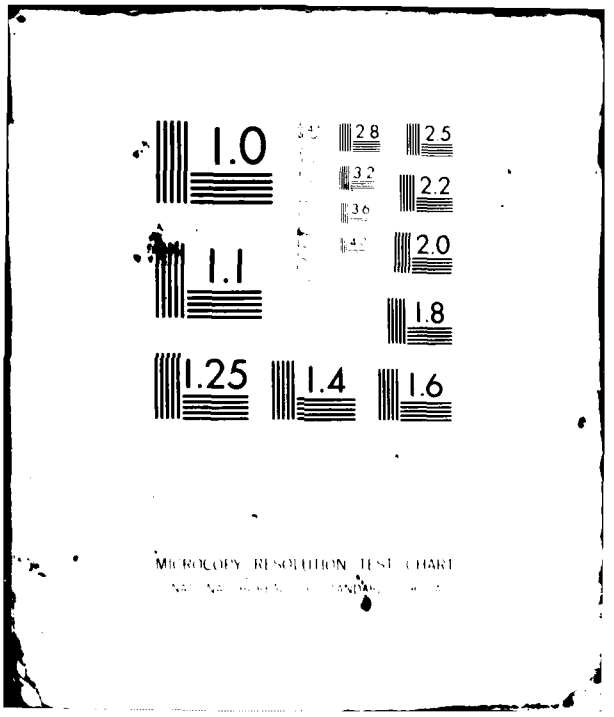
AD-A107 408 TIPPETTS-ABBETT-MCCARTHY-STRATTON NEW YORK F/G 13/13
NATIONAL DAM SAFETY PROGRAM. KIRK LAKE DAM (INVENTORY NUMBER N.--ETC(U)
AUG 81 E O'BRIEN DACW51-81-C-0008

UNCLASSIFIED NL



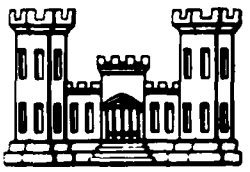

1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART

LOWER HUDSON RIVER BASIN

KIRK LAKE DAM

PUTNAM COUNTY, NEW YORK
INVENTORY NO. N.Y. 682

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



NEW YORK DISTRICT CORPS OF ENGINEERS

SEPTEMBER 1981

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A107 408 / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report Kirk Lake Dam Lower Hudson River Basin, Putnam County, NY Inventory No. 682	5. TYPE OF REPORT & PERIOD COVERED Phase I Inspection Report National Dam Safety Program 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) EUGENE O'Brien	8. CONTRACT OR GRANT NUMBER(s) DACW51-81-C-0008
9. PERFORMING ORGANIZATION NAME AND ADDRESS Tippetts-Abbett-McCarthy-Stratton The TAMS Building 655 Third Avenue New York, New York 10017	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of the Army 26 Federal Plaza New York District, CofE New York, New York 10287	12. REPORT DATE 13 August 1981 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Department of the Army 26 Federal Plaza New York District, CofE New York, NY 10287	15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; Distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

National Dam Safety Program. Kirk Lake Dam (Inventory Number N.Y. 682), Lower Hudson River Basin, Putnam County, New York. Phase I Inspection Report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Kirk Lake Dam
Putnam County
Lower Hudson River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

The examination of documents and the visual inspection of Kirk Lake Dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

411016

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

dam has some deficiencies which require further investigation and remedial action.

Using the Corps of Engineers screening criteria for the initial review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 6.1 percent of the Probable Maximum Flood (PMF). The spillway is therefore adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard for loss of life downstream from the dam.

The structural stability analysis based on available information and visual inspection indicates that the stability against sliding and overturning of the spillway section of the dam is inadequate.

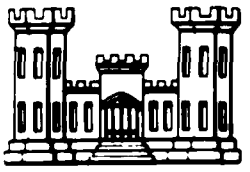
The structural stability analysis based on available information and visual inspection indicates that the stability of the spillway section against sliding is inadequate for the following cases: Case II - normal loading with ice load, Case III - unusual loading 1/2 PMF and Case IV - extreme loading PMF. The stability of the spillway section against overturning is inadequate for Case II - normal loading with ice load, Case III - unusual loading, 1/2 PMF and Case IV - extreme loading, PMF.

LOWER HUDSON RIVER BASIN

KIRK LAKE DAM

PUTNAM COUNTY, NEW YORK
INVENTORY NO. N.Y. 682

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



NEW YORK DISTRICT CORPS OF ENGINEERS

SEPTEMBER 1981

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
KIRK LAKE DAM
I.D. NO. N.Y. 682
D.E.C. NO. 481
LOWER HUDSON RIVER BASIN
PUTNAM COUNTY, N.Y.

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM	Kirk Lake Dam, N.Y. 682
STATE LOCATED	New York
COUNTY LOCATED	Putnam
STREAM	Tributary of Muscoot River
BASIN	Lower Hudson
DATE OF INSPECTION	May 6, 1981

ASSESSMENT

The examination of documents and the visual inspection of Kirk Lake Dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further investigation and remedial action.

Using the Corps of Engineers screening criteria for the initial review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 6.1 percent of the Probable Maximum Flood (PMF). The spillway is therefore adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard for loss of life downstream from the dam.

The structural stability analysis based on available information and visual inspection indicates that the stability against sliding and overturning of the spillway section of the dam is inadequate.

The structural stability analysis based on available information and visual inspection indicates that the stability of the spillway section against sliding is inadequate for the following cases: Case II - normal loading with ice load, Case III - unusual loading 1/2 PMF and Case IV - extreme loading PMF. The stability of the spillway section against overturning is inadequate for Case II - normal loading with ice load, Case III - unusual loading, 1/2 PMF and Case IV - extreme loading, PMF.

It is therefore recommended that within 3 months of notification to the owner, a detailed hydrological and hydraulic investigation be undertaken to more accurately determine the site specific characteristics of the watershed and their affect upon the overtopping potential of the dam. At the same time, a structural stability study of the spillway section should be performed as detailed in Section 6.1c. Within twelve (12) months of the date of notification to the owner, any modification to the structure deemed necessary as a result of investigations, to achieve a spillway capacity adequate to discharge the outflow from at least one-half (1/2) PMF, should have been completed. In the interim, a detailed emergency action plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

In addition, the dam has a number of problem areas which, if left uncorrected, have the potential for the development of hazardous conditions and must be corrected within twelve (12) months.

The following are the recommended measures which must be corrected:

1) All debris should be cleaned out from the downstream channel and hauled away. The collapsed section of the downstream channel should be cleared and repaired.

2) The small saddle near the right abutment contact should be filled in.

3) Stones missing in the masonry spillway section should be replaced.

4) All moving parts of the gate system should be lubricated.

5) Provide a program of periodic inspection and maintenance of the dam and appurtenances including yearly operation and lubrication of the reservoir drainage system. Document this information for future reference. The emergency action plan described in Section 7.1d should be developed and updated periodically during the life of the structure.

Eugene O'Brien, P.E.
New York No. 29823

Approved by:

Col. W. M. Smith Jr.
New York District Engineer

Date: 13 AUG 1981

1. OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
KIRK LAKE DAM
I. D. NO. N.Y. 682
D.E.C. No. 481
LOWER HUDSON RIVER BASIN
PUTNAM COUNTY, N.Y.

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers by Contract No. DACW 651-81-C-008 dated 14 December 1980 in fulfillment of the requirements of the National Dam Inspection Act, Public Law 92-367, 8 August 1972.

b. Purpose of Inspection

The inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF THE PROJECT

a. Description of the Dam and Appurtenant Structures

The Kirk Lake Dam is composed of an approximately 220 foot long stone masonry-earth buttress dam. The crest of the dam is 60 feet wide and its maximum height above the river is 28 feet. The downstream masonry wall face of the dam is vertical. Upstream of the 11 foot thick wall is a 50 foot wide earth embankment with a slight upstream slope. Upstream of the earth embankment is another smaller concrete masonry wall. The slope of the fill upstream of this wall is unknown.

Centrally located within the dam is a 15.5 foot wide stone masonry spillway section which has a 6 feet by 4 feet chamber.

The spillway has sills at three levels and the maximum and minimum depths of the sills are 5.3 feet and 2.3 feet respectively from the top of the dam. At the bottom of the chamber is the control for the reservoir drain. The reservoir drain is a 36-inch cast iron pipe, controlled by a gate valve. The intake is located in the lake approximately 200 feet upstream of the dam. The outlet is in the base of the spillway structure.

The spillway and reservoir drains discharge through a stone masonry lined channel about 15 feet deep.

b. Location

Kirk Lake Dam is located on a tributary of the Muscoot River about 1/2 mile northeast of the village of Mahopac Falls in Putnam County, New York. The dam is about 1/3 mile north of Route 6N near its intersection with Hill Street.

c. Size Classification

The dam is 28 feet high and has a reservoir with a maximum storage capacity of 1,822 acre-feet and therefore is classified as an intermediate dam (storage capacity $> 1{,}000$ acre-feet, $< 50{,}000$ acre-feet).

d. Hazard Classification

The dam is in the "high" hazard potential category because of its close proximity to the village of Mahopac Falls.

e. Ownership

Kirk Lake Dam is owned by the New York City Bureau of Water Supply. The person to contact is Mr. Don Grassman at the Department of Environmental Protection, P.O. Box 66, Valhalla, New York, 10595, Telephone (914) 232-5711.

f. Purpose of Dam

The dam impounds water for a recreational lake.

g. Design and Construction History

The dam was designed and built in 1871 and major reconstruction was done in 1881. The designers and constructors are not known.

h. Normal Operating Procedures

Operations are carried out on an as-needed basis, with the water level maintained at between 1 and 3 feet below the lowest spillway sill. The 36 inch cast iron pipe serves as reservoir drain. The intake of the drain is about 200 ft from the upstream face.

1.3 PERINENT DATA

a. Drainage Area, Square Miles	2.95
b. Discharge at Dam Site, cfs	
Ungated Spillway	279
Maximum Capacity - 36-Inch Cast Iron Pipe	160
Total Discharge Maximum Pool	439
c. Elevation, Feet Above MSL, USGS Datum	
Top of Dam	592.3
Maximum Pool	592.3
Spillway Crest - Lowest Sill	587.0
Spillway Crest - Mid Sill	589.0
Spillway Crest - High Sill	590.3
Invert Low Level Intake	Unknown
Invert Low Level Outlet	568.3
d. Reservoir	
Length of Normal Pool (miles)	0.8
Surface Area of Maximum Pool (Acres)	216
Surface Area of Normal Pool (Acres)	124
e. Storage, Acre-feet	
Reservoir at Spillway Crest	920
Reservoir at Maximum Pool	1822

f. Dam

Type	Masonry Wall with Upstream Earth Embankment
Length (feet)	220
Upstream Slope	Unknown
Downstream Slope	Vertical
Crest Elevation	592.3
Crest Width	61 feet
Grout Curtain	Unknown
Cutoff	Unknown

g. Spillway

Type		Uncontrolled Broad Crested Weir
Size		15 feet wide
Crest Elevations -	Low Sill	587
	Mid Sill	589
	High Sill	590.3
Upstream Channel		Concrete Slab with Masonry Concrete Training Walls
Downstream Channel		Masonry Walled Channel - 15 feet wide base approximately 4V to 1H sloped walls

h. Reservoir Drain and Pipeline

Upstream. The intake for the 36-inch cast iron reservoir drain line is located about 200 feet upstream of the dam. A gate valve, located in a chamber below the spillway, control's discharges. The outlet is located in the base of the spillway section of the dam.

SECTION 2 - ENGINEERING DATA

2.1 GEOLOGY

The records of the owner contain no data on site geology. However, there is data available in the literature on the general geology of the area. Kirk Lake Dam is located in the Hudson Highlands section of the New England Uplands physiographic province. The province is characterized by a low, but rugged mountain range consisting primarily of igneous and metamorphic rock. The rock underlying the area of Kirk Lake is Precambrian biotite-quartz-plagioclase paragneiss with subordinate biotite granitic gneiss, amphibolite and calcilicate rock.

2.2 SUBSURFACE INVESTIGATIONS

There are no records of subsurface investigations carried out at the site. It is known that the surficial soils in the vicinity of the Kirk Lake Dam are coarse grained glacial till material.

2.3 DAM AND APPURTENANT STRUCTURES

There are no records or drawings available with regard to the original construction of the dam in 1872. No records are available of the reconstruction carried out in 1881. There is some information regarding the dam section shown in the inspection reports of 1915 which are included in Appendix

2.4 CONSTRUCTION RECORDS

No information has been located in relation to the construction of the project. The name(s) of the contractor(s) is (are) unknown.

2.5 OPERATION RECORDS

There is no regularly scheduled operation of the dam. The outlets are operated on an as-needed basis to maintain a water level between 1 and 3 feet below the lowest sill of the spillway. Maintenance is performed on an as-needed basis by staff of the owner. No systematic monitoring of the dam is in effect.

2.6 EVALUATION OF DATA

There is sufficient data available to support a Phase I evaluation of the dam.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection of Kirk Lake Dam was made on May 6, 1981. The weather was clear and the temperature was in the mid 60's. At the time of the inspection, the water level in the reservoir was about 1 foot below lowest sill of the spillway.

b. Dam

The stone masonry and earth buttress portions of the dam appears to be in good condition. The vertical and horizontal alignment of the crest appears to be good (see Photos 2 and 3).

The visible portion of the upstream face of the dam is in good condition with some minor ice damage to the upstream wall.

The downstream face of the masonry wall is in good condition except minor vegetation growing through.

There is no emergency action plan for the project.

c. Spillway

The masonry spillway is in good condition. There are a few stones missing in the central portion of the spillway. The approach channel of the spillway is clear and training walls are in good condition except for some local ice damage. The tailrace channel of the spillway is choked with heavy debris and a section of channel wall about 300 feet downstream of the dam (see Photos 5 and 10) is collapsed.

d. Outlets and Pipes

The condition of the reservoir drain and in and intake could not be determined because it was unobservable. The control for the gate valve is in good operating condition but requires lubrication. The 36-inch reservoir drain pipeline was unobservable. The outlet of the pipe appears to be in good condition. The discharge was free of sediment or rust staining (see Photo 7) and therefore the condition of the reservoir drain could not be determined.

e. Abutments

The abutment contact and abutment at the left end of the dam are in good condition. The right abutment is in good condition, however, a small "ditch" passes over the contact. The ditch is slightly lower than crest and at the time contained some standing water (see Photo 11).

f. Reservoir Area

The reservoir area is hilly and for the most part, developed with small homes. There is some forested area surrounding the reservoir and the area to the north is marshy land. There are neither slides, rockfalls or sloughing around the reservoir.

3.2 EVALUATION OF OBSERVATIONS

Visual observations made during the course of the inspection did not indicate any serious problems which would adversely affect the adequacy of the dam and appurtenant facilities. The following is a list in order of importance of problem areas encountered which should be corrected before further deterioration results in the development of a hazardous condition. Appropriate remedies are also included.

1) The downstream channel for the spillway and reservoir drain is filled with debris, and a section of the channel wall has collapsed resulting in the clogging of the channel. The debris should be removed and hauled away and the collapsed section of the channel should be repaired.

2) The small drainage ditch which is near the right abutment contact is subject to flow conditions during high water. This ditch should be filled in with properly compacted earth to an elevation equal to the crest elevation of the dam.

3) Stones have been pried loose in the spillway. These stones should be replaced. Additionally, concrete damaged by ice in the approach channel should be repaired.

4) All moving parts of the outlet system should be lubricated.

5) A program of periodic inspection and maintenance of the dam and appurtenances, should be provided including yearly

lubrication of the moving parts of the outlet system. The inspection and the test operations should be documented for future reference. The emergency action plan described in Section 7.1d should be maintained and updated during the life of the project.

SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

No written operation and maintenance procedure manuals exist for the project. Normal operation of the project consists of maintaining a reservoir level about 1 to 3 feet below lowest sill of the spillway by releasing the discharge through the reservoir drain.

4.2 MAINTENANCE OF THE DAM

There is no regular maintenance schedule for the dam. Maintenance and repairs which are required are carried out by the staff of the owner under the direction of Mr. Birrel, Assistant Civil Engineer for the Bureau of Water Supply.

4.3 WARNING SYSTEM IN EFFECT

No warning system is in effect or in preparation.

4.4 EVALUATION

The overall maintenance of the Kirk Lake Dam is considered inadequate in the following areas.

1) The downstream channel for the spillway and outlet needs to be cleaned out.
2) Moving parts of the outlet works require lubrication.
3) Vegetation, although minor, at the downstream face of the dam, should be removed.

SECTION 5 - HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

The Kirk Lake Dam is located on an unnamed tributary of the Muscoot River about 1/2 mile north of Mahopac Falls, Carmel Township, Putnam County. The Hydrologic Unit Code number for this area is 02030101. The drainage basin extends north of the lake with an area of 2.95 square miles. The basin consists of a north/south valley with approximately 15 percent swamp area in the middle and steep slopes at the edges. About 30 percent of the basin is suburban with the remaining 70 percent being wooded slopes.

5.2 ANALYSIS CRITERIA

The analysis of the adequacy of the spillway was performed by developing a design flood, using the unit hydrograph method and the Probable Maximum Precipitation (PMP). The all season 200 square mile 24 hours PMP for the Carmel area is 22 inches (Weather Bureau sources). The unit hydrograph was computed by the Snyder method using coefficient of 2 and 0.625 for C_t and C_p, respectively. The inflow hydrograph was developed by the U.S. Army Corps of Engineers HEC-1DB computer program. Initial loss of 1.0 inch and constant loss of 0.1 inch/hour were estimated as representative of the basin for the design storm.

In accordance with the Recommended Guidelines for Safety Inspection of Dams (Ref. 3), the adequacy of the spillway was analyzed using the Probable Maximum Flood (PMF). A multi-ratio analysis was performed for the full, 0.75, 0.50 and 0.25 PMF.

5.3 SPILLWAY CAPACITY

The spillway, which is centrally located in the dam, is a 15.5 feet wide stone masonry structure. The spillway has broad crested overflow sills at several different heights. The maximum and minimum depths of the sills are 5.3 feet and 2.3 feet from the top of the dam respectively. The computed maximum discharge over the sills with the water surface at El 592.3 (top of dam) is 309.7 cfs.

5.4 RESERVOIR CAPACITY

The normal reservoir capacity is listed as 920 acre-feet. The computed surcharge storage of 901.7 acre-feet, while water level reaches the top of the dam (592.3 feet MSL), is equivalent to approximately 5.7 inches of runoff over the entire basin.

5.5 FLOODS OF RECORD

There are no records available of floods or maximum lake elevation.

5.6 OVERTOPPING POTENTIAL

The potential of the dam being overtopped was investigated on the basis of the spillway discharge capacity and the available surcharge storage to meet the selected design flood inflows.

The analysis was performed assuming that the reservoir level was at the lowest sill of the spillway at the start of the flood event.

Ratio of PMF	Inflow Peak (cfs)	Overtopping (ft)	Outflow Peak (cfs)
1.00	8006	3.56	5070
0.75	6004	2.65	3401
0.50	4003	1.37	1496
0.25	2001	0.00	217

The analysis indicates that the spillway is capable of passing 6.1 percent of the PMF without overtopping the dam.

5.7 EVALUATION

The spillway at Kirk Lake Dam does not have sufficient spillway capacity to pass either the PMF or one-half (1/2) PMF without overtopping the dam. The overtopping of the dam could cause the failure of the dam, thus significantly increasing the hazard for the loss of life downstream. The spillway is therefore assessed as being "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual observations did not indicate any structural problems with the embankment or appurtenant structures with the reservoir at its present level. There are no observable adverse conditions which would affect the stability of the dam at the present time.

b. Design and Construction Data

There are no design calculations or construction data available.

On the basis of performance, visual inspection, as well as engineering judgment, the embankment and appurtenant structures appear to be adequate with the reservoir at its present level.

c. Stability Analysis

As there were no drawings available, the structural stability of the masonry spillway section was analyzed based on an assumed typical section and field measurements. Stability analysis for the spillway section was done in accordance with the Corps of Engineers Recommended Guidelines. (Reference 3). The following table shows the loading cases considered and the results of the analysis.

Loading Case	Overturning (see Appendix E)	Sliding factor of Safety (see Appendix E)
I) Normal Loading Condition with reservoir at Spillway Crest, No Ice Load	Inside of Middle 1/3	3.41
II) Normal Loading Condition with Reservoir at Spillway Crest, with Ice Load	0.63 ft. Outside of Middle 1/3	2.20

Loading Case		Overturning (see Appendix E)	Sliding Factor of Safety (see Appendix E)
III)	Unusual Loading, One-Half (1/2) PMF, water overtopping the dam by 1.18 feet	0.75 ft. Outside of Middle 1/3	1.68
IV)	Extreme Loading: PMF-water overtopping the dam by 3.29 feet	1.75 ft. Outside of Middle 1/3	1.40
V)	Unusual Loading; Reservoir level of spillway crest, 0.05 g earthquake force	Inside of Base	2.52

The structural stability analysis based on available information and visual inspection indicates that the stability of the spillway section against sliding is inadequate for the following cases: Case II - normal loading with ice load, Case III - unusual loading 1/2 PMF and Case IV - extreme loading PMF. The stability of the spillway section against overturning is inadequate for Case II - normal loading with ice load Case III - unusual loading, 1/2 PMF and Case IV - extreme loading PMF.

Since exact geometry of the spillway section, foundation conditions, upstream backfill characteristics and extent, as well as the extent and magnitude of the uplift pressure are unknown, it is recommended that a more detailed structural stability study be performed. The study should include field investigations to obtain more information regarding the extent and characteristics of the backfill and foundation materils, as well as the quality and condition of the observable masonry of the structure. Based on the results of the analysis, modifications to the spillway should be recommended.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

Examination of the available documents and visual inspections of the Kirk Lake Dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further investigation and remedial action.

Using the Corps of Engineers screening criteria for review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 35 percent of the PMF. The overtopping of the dam could cause the erosion of both abutments, resulting in dam failure, thus signficantly increasing the hazard for loss of life downstream. The spillway is therefore adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

The structural stability analysis based on available information and visual inspection indicates that the stability of the spillway section against sliding is inadequate for the following cases: Case II - normal loading with ice load, Case III - unusual loading 1/2 PMF and Case IV - extreme loading PMF. The stability of the spillway section against overturning is inadequate for Case II - normal loading with ice load, Case III - unusual loading, 1/2 PMF and Case IV - extreme loading PMF.

b. Adequacy of Information

The information and data available were adequate for the performance of a Phase I inspection, except as noted in Sections 6.1c and 6.1d.

c. Need for Additional Investigations

Since the spillway is considered to be "seriously inadequate", additional hydrologic/hydraulic investigations are required to more accurately determine the site specific characteristics of the watershed. After the in-depth hydrologic/hydraulic investigations have been completed, remedial measures must be initiated to provide spillway capacity sufficient to discharge the outlet from the one-half (1/2) PMF event. In addition, an investigation of the structural stability of the spillway portion of the dam is required.

d. Urgency

The additional hydrologic/hydraulic investigations and the stability investigation which are required must be initiated within 3 months from the date of notification. Within 18 months of notification, remedial measures determined as a result of these investigations must be initiated, with completion of these measures during the following year. In the interim, develop an emergency action plan for the notification of downstream residents and proper government authorities in the event of overtopping and provide around-the-clock surveillance of the dam during periods of extreme runoff. The other problem areas listed below must be corrected within one year from notification.

7.2 RECOMMENDED MEASURES

The following are the recommended measures.

1) The results of the aforementioned investigation will determine the appropriate remedial measures required regarding spillway.

2) All debris should be cleaned out of the downstream channel and hauled away. The collapsed section of the downstream channel should be cleared out and repaired.

3) The small saddle near the right abutment contact should be filled in with properly compacted earth.

4) Stones missing in the spillway section should be replaced.

5) A program of periodic inspection and maintenance of the dam and appurtenances should be provided including yearly operation and lubrication of the repaired gates. The emergency action plan described in Section 7.1b should be maintained and updated periodically during the life of the structure. The inspection and the test operation should be documented for future reference.

DRAWINGS

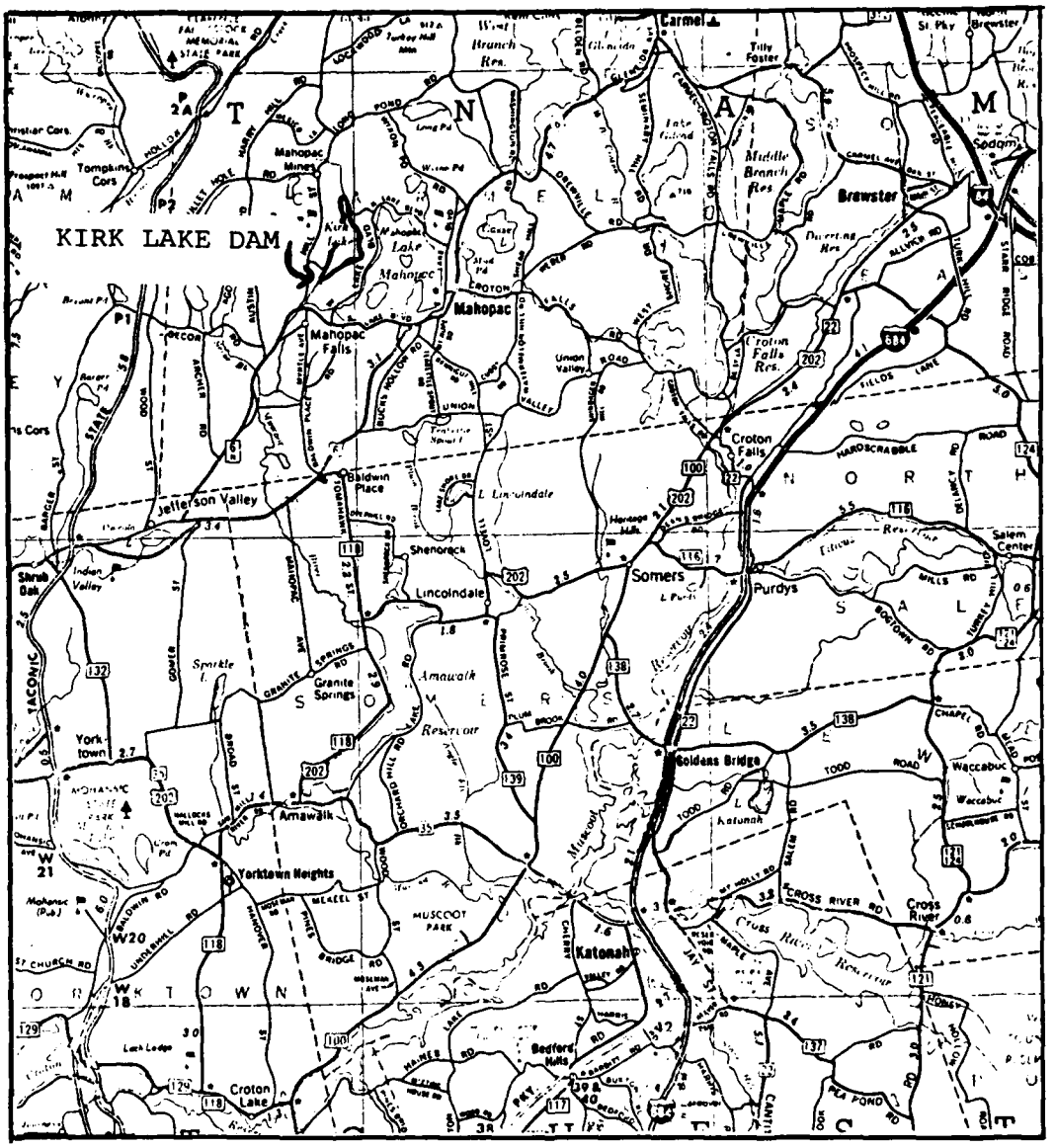
a. Vicinity Map

b. Topographic Map

c. General Location Plan (DWG # 1)

d. Spillway Plan and Sections (DWG # 2)

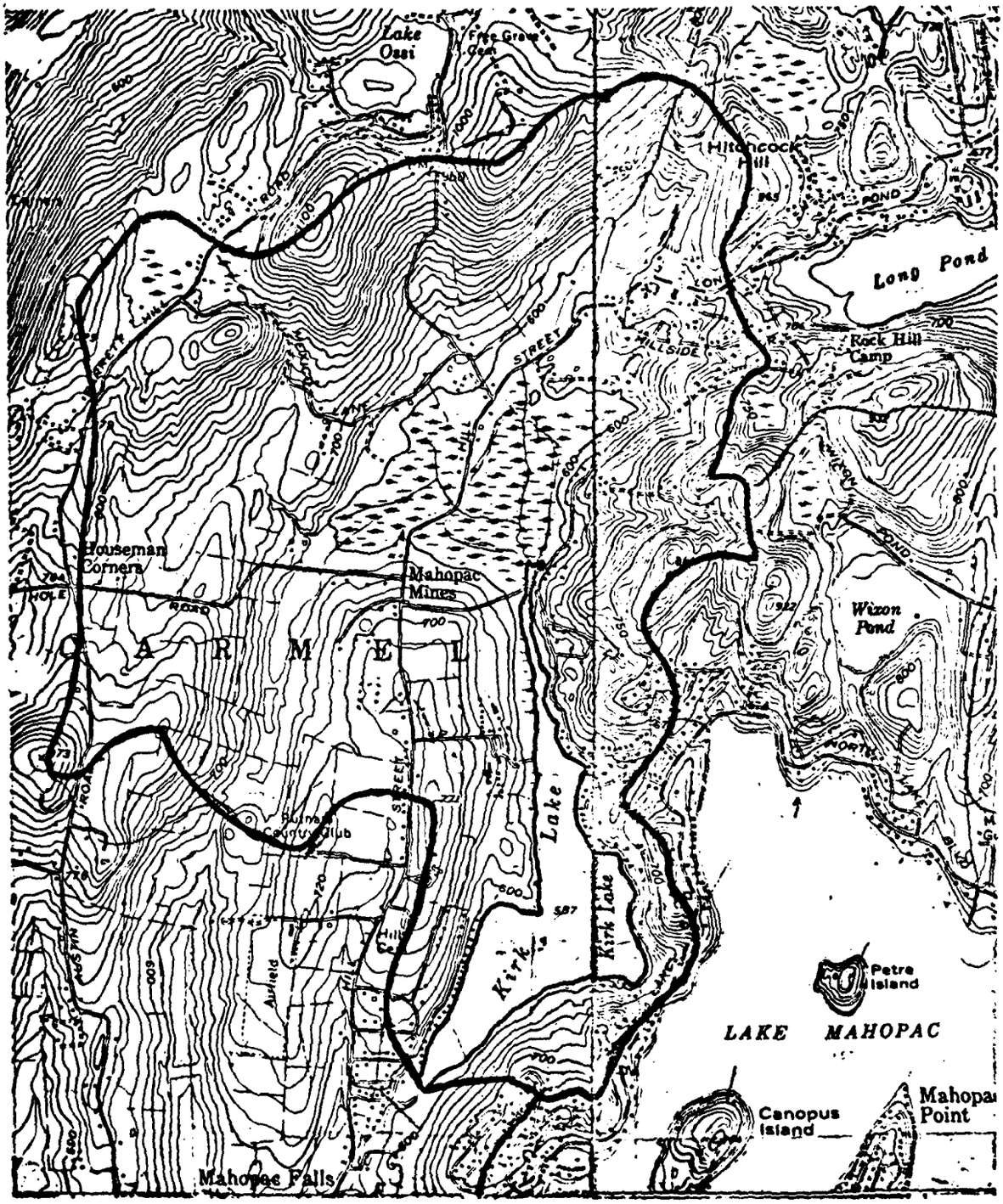
APPENDIX A



Scale: 1"=2.2 Miles

KIRK LAKE DAM

VICINITY MAP

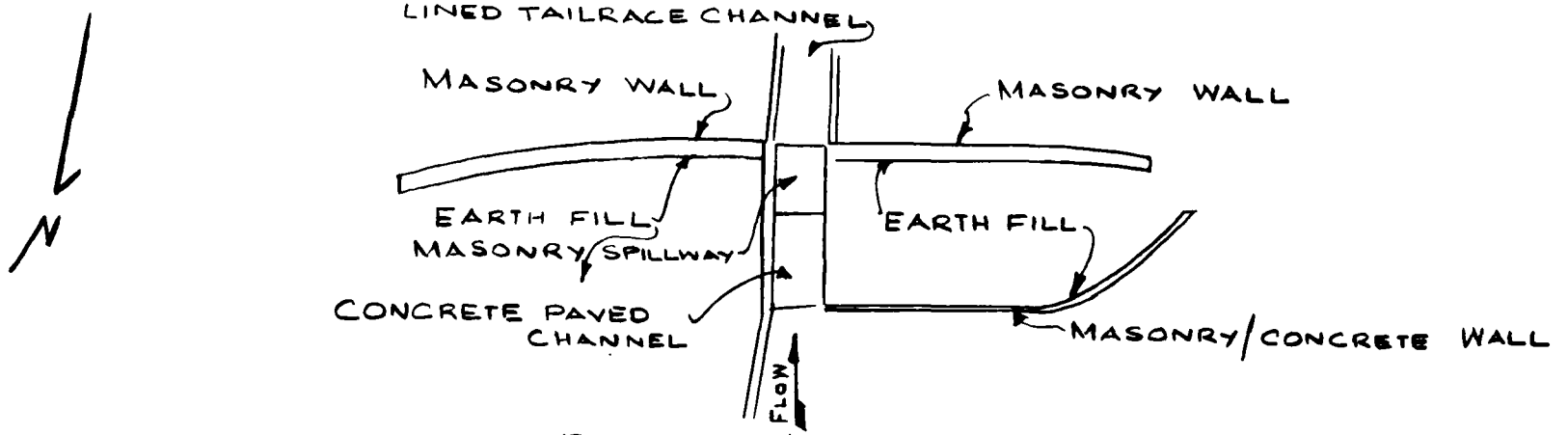


SCALE 1:24000

LAKE CARMEL,N.Y. AND OSCAWANA LAKE,N.Y.

QUAD TOPOGRAPHIC MAP

KIRK LAKE DAM



PLAN - KIRK LAKE DAM

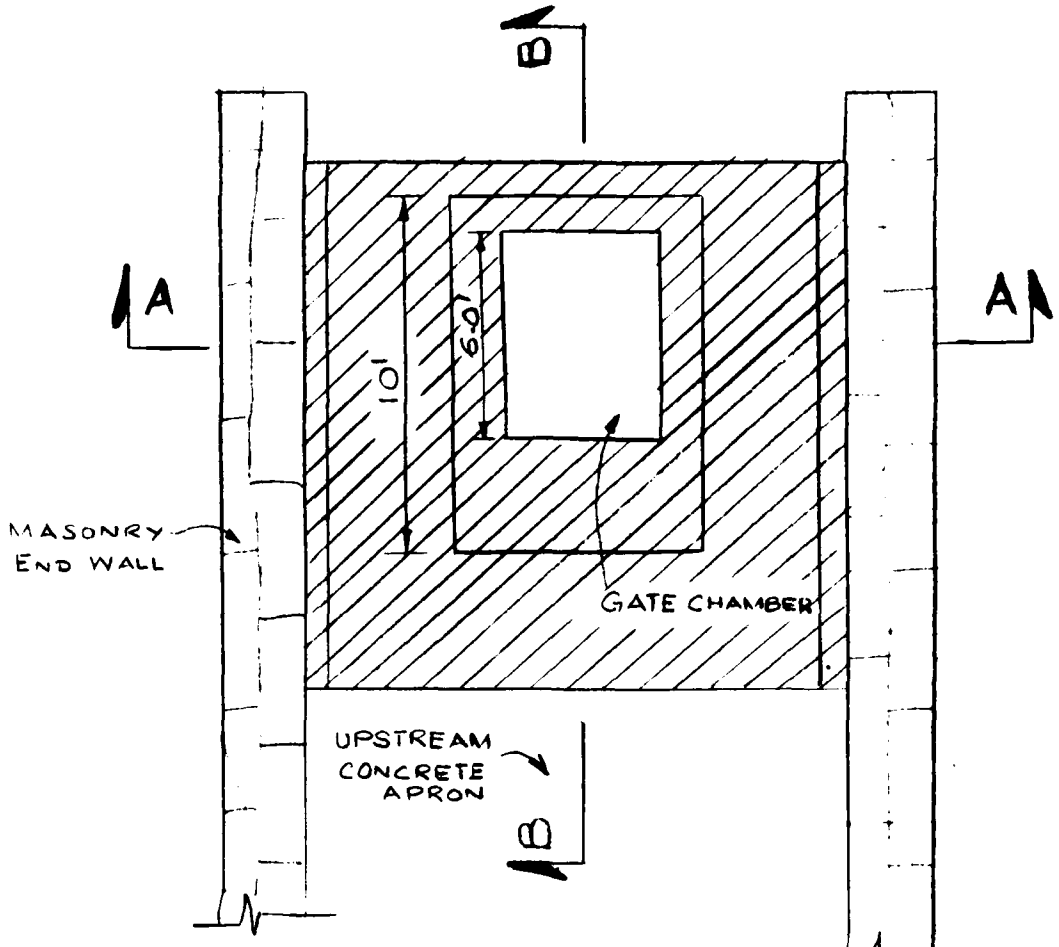
SCALE: 1" = 50'

NOTES:

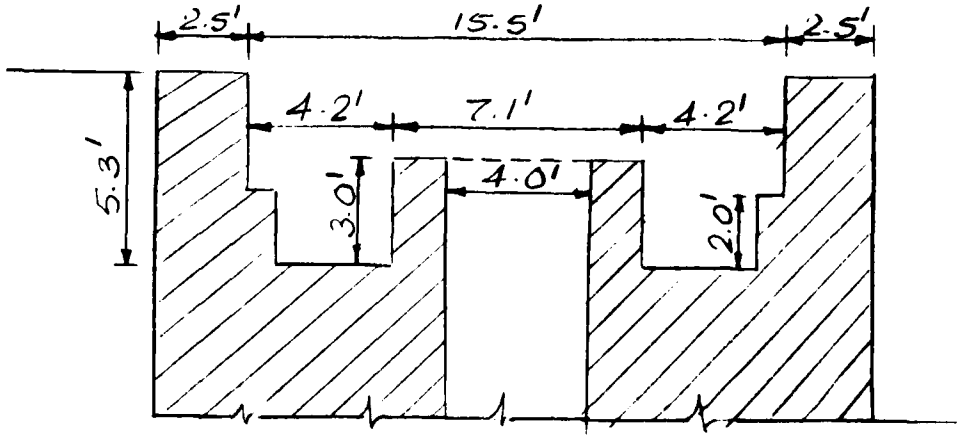
i) For Details of Spillway See Drawing No. 2

ii) All dimensions from field measurements.

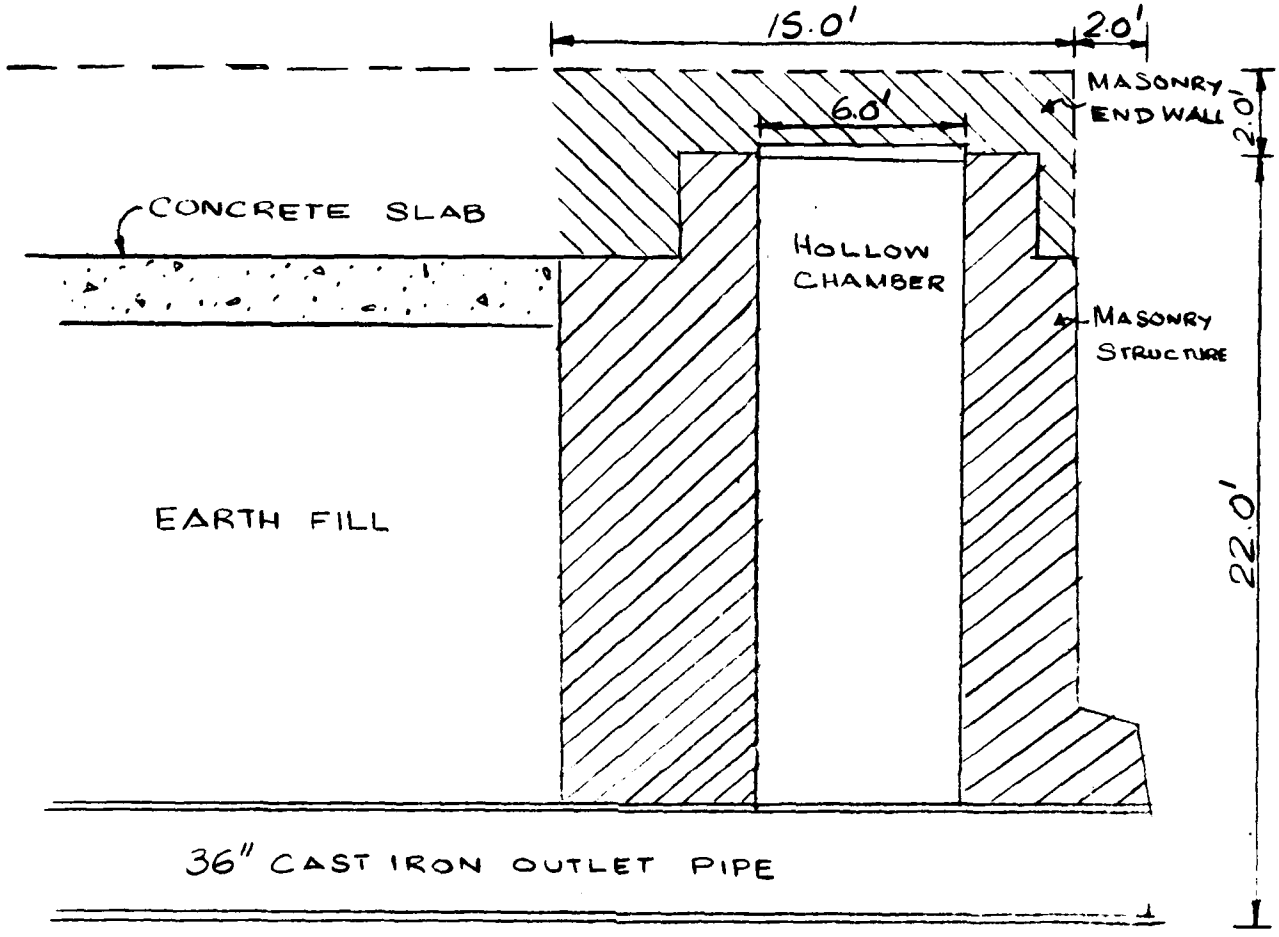
DWG # 1



PLAN
SCALE: 1"=5'



SECTION A-A
SCALE 1"=5'



SECTION B-B

SCALE: 1" = 5'

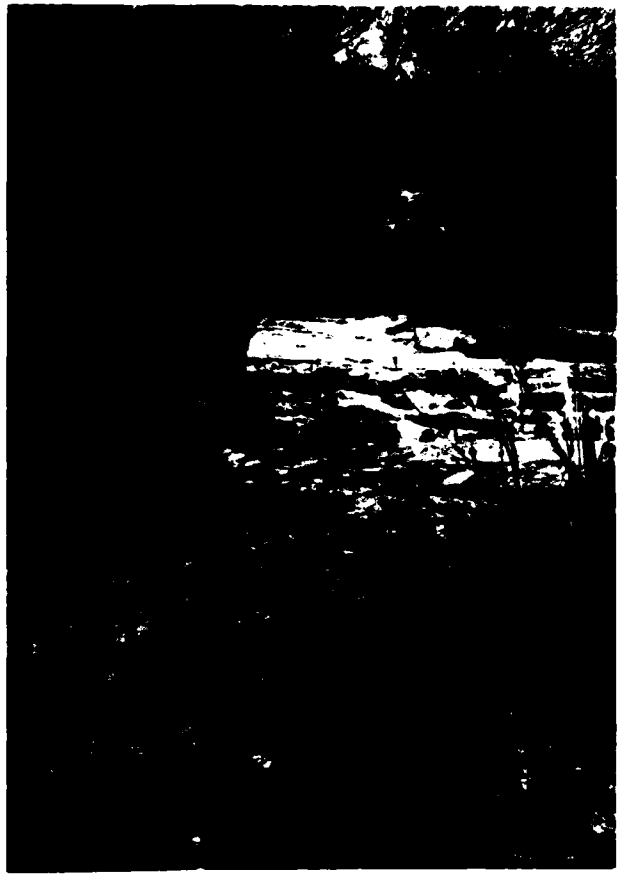
SPILLWAY - PLAN & SECTIONS

KIRK LAKE DAM

DWG #2

PHOTOGRAPHS

APPENDIX B

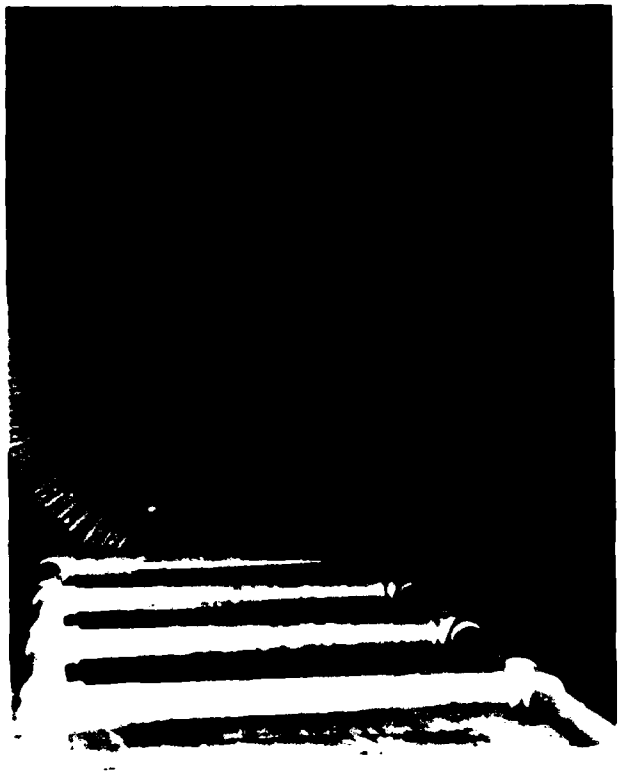


2. VIEW ALONG CREST OF DAM FROM THE RIGHT ABUTMENT.

3. VIEW ALONG CREST OF DAM FROM LEFT ABUTMENT.

4. VIEW OF SPILLWAY APPROACH CHANNEL

5. VIEW OF TAILRACE CHANNEL

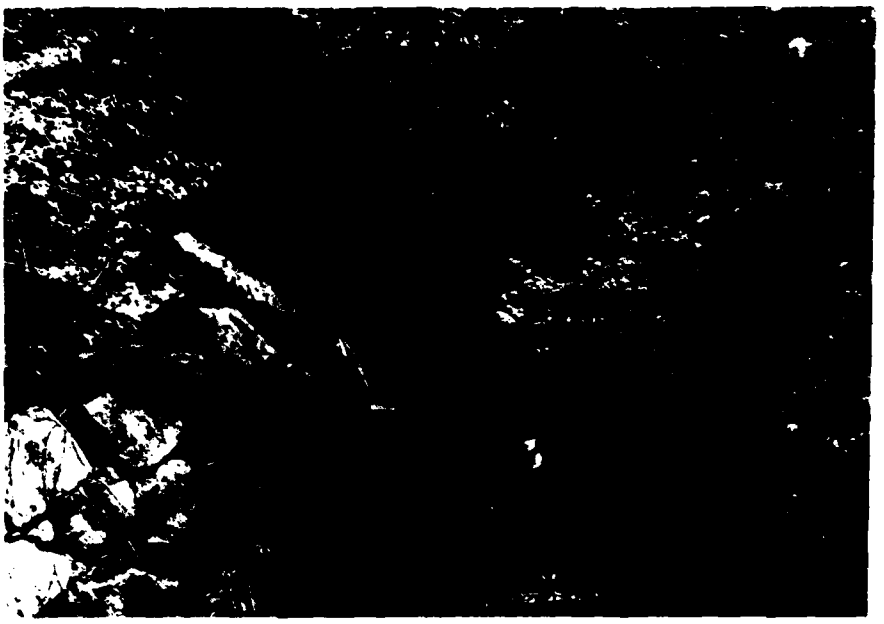


6. CONTROL FOR LOW LEVEL OUTLET

7. CLOSEUP OF LOW LEVEL OUTLET

8. UPSTREAM VIEW OF SPILLWAY

9. DOWNSTREAM VIEW OF SPILLWAY



10. VIEW OF COLLAPSED PORTION OF TAILRACE CHANNEL

11. VIEW OF LOW SADDLE NEAR RIGHT ABUTMENT CONTACT.

VISUAL INSPECTION CHECKLISTS

APPENDIX C

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Kirk Lake Dam

Fed. I.D. # NY 682 DEC Dam No. 481

River Basin Lower Hudson

Location: Town Carmel County Putnam

Stream Name Tr Muscoot River

Tributary of Muscoot River

Latitude (N) 41-22.7 Longitude (W) 73-45.5

Type of Dam Masonry with earth fill upstream

Hazard Category High

Date(s) of Inspection May 6 1981

Weather Conditions FAIR 65°F

Reservoir Level at Time of Inspection 1.5 below Spillway Crest

b. Inspection Personnel K Szalay, J Fiteni JR.

c. Persons Contacted (Including Address & Phone No.) MR. C Picha, (914) 232-5171
NYC Dept. of Env. Protection, PO Box 66 Valhalla, N.Y. 10595
MR. Birrell - (914) 225-3550.

d. History:

Date Constructed 1871 Date(s) Reconstructed 1881

Designer Unknown

Constructed By Unknown

Owner NYC. Dept. of Env. Conservation

(4) Slope Protection Concrete Wall - good condition

(5) Surface Cracks or Movement at Toe None

d. Downstream Slope

(1) Slope (Estimate - V:H) Vertical Masonry Wall

(2) Undesirable Growth or Debris, Animal Burrows None

(3) Sloughing, Subsidence or Depressions None

(4) Surface Cracks or Movement at Toe None

(5) Seepage None

(6) External Drainage System (Ditches, Trenches; Blanket) None

(7) Condition Around Outlet Structure Structure in good condition, channel debris clogged

(8) Seepage Beyond Toe None

e. Abutments - Embankment Contact

Left abutment - good

Right abutment - small depression below crest level.

(1) Erosion at Contact None

(2) Seepage Along Contact Evidence of possible past seepage in right abutment contact at higher reservoir levels

3) Drainage System

a. Description of System One 36 inch ϕ cast iron low level outlet pipe. Controlled From well in middle of spillway by slide gate. Intake located about 400' out in lake. Control by multigear wheel

b. Condition of System good operating condition

c. Discharge from Drainage System regulated by Mr Birrel - Discharging at time of visit. Usual condition is to discharge controlled amounts.

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)

None

5) Reservoir

a. Slopes Hilly - Some development - Generally Glacial Till material - Stable

b. Sedimentation Some minor amounts

c. Unusual Conditions Which Affect Dam None

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) Few homes (10) downstream, Highway 6N about ½ mile d/s

b. Seepage, Unusual Growth None obvious

c. Evidence of Movement Beyond Toe of Dam None

d. Condition of Downstream Channel Downstream channel is paved Much debris, one collapsed section

7) Spillway(s) (Including Discharge Conveyance Channel)

Multi-leveled structure approximately in center of dam, Masonry walls and bottom

a. General good condition, few stones missing due to recent vandalism, approach channel clear, some ice damage to training walls. Downstream channel good but clogged by debris.

b. Condition of Service Spillway Good condition few stones missing

c. Condition of Auxiliary Spillway None

d. Condition of Discharge Conveyance Channel Channel is clogged by debris, natural as well as dumped. Stone paved channel has collapsed at one section about 400' D/s of dam.

3) Reservoir Drain/Outlet

Type: Pipe ✓ Conduit _____ Other _____

Material: Concrete _____ Metal ✓ Other _____

Size: 36" Length ≈ 400'

Invert Elevations: Entrance unknown Exit 560

Physical Condition (Describe): UNknown Unobservable ✓

Material: _____

Joints: _____ Alignment _____

Structural Integrity: _____

_____

Hydraulic Capability: _____

_____

Means of Control: Gate ✓ Valve _____ Uncontrolled _____

Operation: Operable ✓ Inoperable _____ Other _____

Present Condition (Describe): good - needs lubrication

_____

9) Structural

a. Concrete Surfaces — MASonry Surfaces are in generally good condition, Few missing blocks

b. Structural Cracking None Visible

c. Movement - Horizontal & Vertical Alignment (Settlement) None Visible or evident

d. Junctions with Abutments or Embankments Good condition

e. Drains - Foundation, Joint, Face None

f. Water Passages, Conduits, Sluices None

g. Seepage or Leakage None Visible

h. Joints - Construction, etc. Masonry joints in good condition, repaired as required

i. Foundation No evidence of or visible problems

j. Abutments good condition

k. Control Gates good operating condition (See Items)

l. Approach & Outlet Channels Approach channel wall - some concrete deterioration - otherwise ok. outlet channel - good condition except one section collapsed ± 300 ft downstream, debris throughout

m. Energy Dissipators (Plunge Pool, etc.) None

n. Intake Structures Not visible

o. Stability Visually ok - To be Calculated

p. Miscellaneous —

HYDROLOGIC DATA AND COMPUTATIONS

APPENDIX D

CREST: ELEVATION: 592

Type: Masonry Walls

Width: 11 Feet Length: 205

Spillover Masonry Structure - 15.5 Feet wide - Stepped

Location Near Center of DAM

SPILLWAY:

SERVICE		AUXILIARY
Varies 587 → 590	Elevation	
Masonry - Broad Crested	Type	
15.5 feet	Width	
	Type of Control	
✓	Uncontrolled	
	Controlled:	
	Type (Flashboards; gate)	
	Number	
	Size/Length	
	Invert Material	
	Anticipated Length of operating service	
≈ 100 feet	Chute Length	
Slopes 4/s ≈ 3 feet beyond that un-observable	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

HYDROMETEROLOGICAL GAGES:

Type : None Used

Location: _____

Records:

Date - _____

Max. Reading - _____

FLOOD WATER CONTROL SYSTEM:

Warning System: None

_____

Method of Controlled Releases (mechanisms):

_____

_____

DRAINAGE AREA: 2.95 sq. miles

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Rural

Terrain - Relief: Hilly

Surface - Soil: Glacial Till

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

Potential Sedimentation problem areas (natural or man-made; present or future)

None

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

None

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: None

Elevation:

Reservoir:

Length @ Maximum Pool 0.8 (Miles)

Length of Shoreline (@ Spillway Crest) 3.1 (Miles)

TAMS

Job No. 1579-13 Sheet 1 of _____

Project KIRK LAKE DAM. Date JAN 21, 1981

Subject _____ By D.L.C.

_____ Ch'k. by _____

LAKE EL. 587' MSL

LAKE PERIMETER 8.25" / 16,500' / 3.13 mi.

FETCH 4000'

LAKE AREA

4236
4105 1.31

1.35 123.97 ac

1057
0918 1.39

DRAINAGE AREA

5800
3731 20.69

20.59 1890.73 / 2.95 mi²

4105
2056 20.49

600 FT CONTOUR

.6582

3.79

.6203 3.815. 350.32 ac

3.82

.5521

620 FT CONTOUR

TAMS

Job No. 1579-13 Sheet 2 of _____

Project KIRK LAKE DAM Date 1/81

Subject 600 CONTOUR LINE AREA By A. PERDOMO

Ch'k. by _____

PLAN. RDNG

	Sq. INC.		ACRES	Sq. MILES
4235 / 3865	> 3.70			
		> 3.71	340.6	0.532
4606 / 4235	> 3.71			

TAMS

Job No. 1579-04 Sheet 3 of _____
Project KIRK LAKE Date 7-20-81
Subject HYDROLOGIC/HYDRAULIC COMPUTATION By D.L.C.
Ch'k. by _____

EL	H	H_1	L_1	Q_1	H_2	L_2	Q_2	H_3	L_3	Q_3	Q_{TOTAL}
587	0										0
588	1		6.8	18.0							18.0
589	2		"	50.8	0						50.8
590	3		"	93.3	1	1.6	4.2	0		0	97.5
591	4		"	143.6	2	"	11.9	1	7.1	18.7	174.2
592.3	5.3		"	219.0	3.3	"	25.3	2.3	"	65.4	309.7
594	7		"	332.5	5.	"	47.2	4	"	150.0	529.7
597	10.		"	567.7	8	"	95.6	7	"	347.1	1010.4

USE C = 2.64

LOW LEVEL OUTLET IS ASSUMED CLOSED FOR PMF ANALYSIS

EL FT	ΔH (FT)	AREA (Ac)	MEAN AREA (Ac)	ΔVOL (Ac Ft)	SURCHARGE STORAGE (Ac Ft)
587		124			0
	3		150.1	450.3	
590		176.2			450.3
	2.3		196.25	451.4	
592.3		216.3			901.7
	2.7		239.8	647.5	
595		263.3			1549.2
	5.0		306.8	1534.0	
600		350.3			3083.2

TAMS

Job No. 1579 Sheet 4 of _____
Project KIRK LAKE DAM INSPECTION Date MAY 18 1981
Subject HYDROLOGIC / HYDRAULIC COMPUTATIONS By D.L.C
Ch'k. by _____

FROM HYDROMET #33

ALL SEASON 200 SQ MILE 24 hour PMP = 22 inches

DURATION IN HOURS	Percent of INDEX RAINFALL
6	112
12	123
24	133
48	141

Assume INITIAL LOSS ≃ 1.0 inches

& CONSTANT LOSS ≃ 0.1 inch/hour

% IMPERVIOUS AREA 0.1

ASSUME SNYDER COEFS C_p ≃ 0.625 ie 640 C_p = 400

& C_T ≃ 2.0

L = 3.75" = 7500' = 1.4 mi

L_{CA} 0.9" = 1800' = 0.34 mi

$t_p = C_T(L L_{CA})^{0.3} = 2(1.4 \times 0.34)^{.3} = 1.6$ hours

$t_R = t_p/5.5 = 1.6/5.5 = 0.29$ hrs use t_R = 0.5 hrs.

$t_{pR} = t_p + 0.25(t_R - t_R) = 1.6 + 0.25(0.5 - 0.29)$

$= 1.6 + 0.05 = 1.65$ hours

TAMS

Job No. 1579-13 Sheet 5 of ____

Project KIRK LAKE Date 5/20/21

Subject HYDROLOGIC/HYDRAULIC COMPUTATIONS By D.K. BOFAH

Ch'k. by ____

Basin area = 2.95 Sq. miles

Water Surface area:

Lake = 0.194 Sq. Miles

Swamps etc. = 0.155

Total = 0.299 Sq. miles

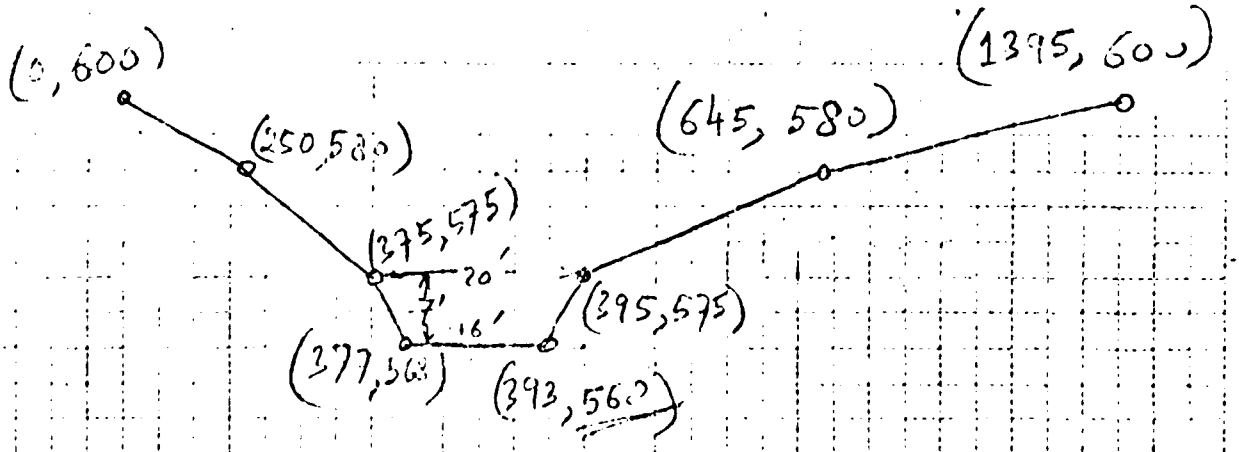
Ratio of water surface area to total basin area = 0.101
≃ 0.1

D/S channel characteristics

Length = 1000 ft.

Slope = 1:100 = 0.012

Cross Section:



```
*********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
 LAST MODIFICATION   01 APR 80
*********************************

   1       A1                            KIRK LAKE DAM
   2       A2                          PHASE 1 INSPECTION
   3       A3                       HEC-1DB PMF ANALYSIS  MAY 81
   4       B      100        0       30        0        0        0        0        0        0        0
   5       B1       5
   6       J        1        4        1
   7       J1       1      .75       .5      .25
   8       K        0        1                                            1
   9       K1       1 BASIN INFLOW HYDROGRAPH
  10       M        1        1     2.95              2.95                                   1
  11       P                22      112      123      133      141
  12       T                                                              1       .1                 0.1
  13       W     1.65    0.625
  14       X       -1      -.1      1.5
  15       K        1        2                                            1
  16       K1       2 ROUTE THROUGH LAKE
  17       Y                                   1        1
  18       Y1       1                                                   920       -1
  19       Y4     587      588      589      590      591    592.3      594      597
  20       Y5       0     18.0     50.8     97.5    174.2    309.7    529.7   1010.4
  21       $S     920   1370.3   1821.7   2469.2   4003.2
  22       $E     587      590    592.3      595      600
  23       $$     587
  24       $D   592.3     3.09      1.5      234
  25       K        1        3                                            1
  26       K1       3 CHANNEL ROUTE D/S OF DAM
  27       Y                                   1        1
  28       Y1       1
  29       Y6   0.035    0.017    0.035      568      600     1000    0.012
  30       Y7       0      600      250      580      375      575      377      568      393      568
  31       Y7     395      575      645      580     1395      600
  32       K       99
```

Sheet 6 of 21

```
PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

        RUNOFF HYDROGRAPH AT          1
        ROUTE HYDROGRAPH TO           2
        ROUTE HYDROGRAPH TO           3
        END OF NETWORK
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
END OF NETWORK	

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 01 APR 80
****

RUN DATE= 81/07/21.
TIME= 12.35.53.

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 01 APR 80

RUN DATE= 81/07/21.
TIME= 12.35.53.

KIRK LAKE DAM
PHASE 1 INSPECTION
HEC-1DB PMF ANALYSIS MAY 81

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	30	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= 1.00 .75 .50 .25

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

1 BASIN INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.95	0.00	2.95	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	112.00	123.00	133.00	141.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	.10

UNIT HYDROGRAPH DATA
TP= 1.65 CP= .63 NTA= 0

RECESSION DATA
STRTQ= -1.00 QRCSN= -.10 RTIOR= 1.50
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.93 AND R= 2.98 INTERVALS

UNIT HYDROGRAPH 18 END-OF-PERIOD ORDINATES, LAG= 1.66 HOURS, CP= .63 VOL= 1.00

99.	351.	609.	700.	588.	419.	299.	213.	152.	108.
77.	55.	39.	28.	20.	14.	10.	7.		

Sheet 8 of 21

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.30	1	.00	.00	.00	3.	1.02	1.30	51	.06	.01	.05	17.
1.01	1.00	2	.00	.00	.00	3.	1.02	2.00	52	.06	.01	.05	26.
1.01	1.30	3	.00	.00	.00	3.	1.02	2.30	53	.06	.01	.05	33.
1.01	2.00	4	.00	.00	.00	3.	1.02	3.00	54	.06	.01	.05	39.
1.01	2.30	5	.00	.00	.00	3.	1.02	3.30	55	.06	.01	.05	43.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.30	1	.00	.00	.00	3.	1.02	1.30	51	.06	.01	.05	17.
1.01	1.00	2	.00	.00	.00	3.	1.02	2.00	52	.06	.01	.05	26.
1.01	1.30	3	.00	.00	.00	3.	1.02	2.30	53	.06	.01	.05	33.
1.01	2.00	4	.00	.00	.00	3.	1.02	3.00	54	.06	.01	.05	39.
1.01	2.30	5	.00	.00	.00	3.	1.02	3.30	55	.06	.01	.05	43.
1.01	3.00	6	.00	.00	.00	3.	1.02	4.00	56	.06	.01	.05	45.
1.01	3.30	7	.00	.00	.00	3.	1.02	4.30	57	.06	.01	.05	47.
1.01	4.00	8	.00	.00	.00	3.	1.02	5.00	58	.06	.01	.05	49.
1.01	4.30	9	.00	.00	.00	3.	1.02	5.30	59	.06	.01	.05	50.
1.01	5.00	10	.00	.00	.00	3.	1.02	6.00	60	.06	.01	.05	50.
1.01	5.30	11	.00	.00	.00	3.	1.02	6.30	61	.16	.12	.05	61.
1.01	6.00	12	.00	.00	.00	3.	1.02	7.00	62	.16	.12	.05	98.
1.01	6.30	13	.01	.00	.01	3.	1.02	7.30	63	.16	.12	.05	160.
1.01	7.00	14	.01	.00	.01	3.	1.02	8.00	64	.16	.12	.05	232.
1.01	7.30	15	.01	.00	.01	4.	1.02	8.30	65	.16	.12	.05	283.
1.01	8.00	16	.01	.00	.01	4.	1.02	9.00	66	.16	.12	.05	336.
1.01	8.30	17	.01	.00	.01	4.	1.02	9.30	67	.16	.12	.05	367.
1.01	9.00	18	.01	.00	.01	4.	1.02	10.00	68	.16	.12	.05	388.
1.01	9.30	19	.01	.00	.01	5.	1.02	10.30	69	.16	.12	.05	404.
1.01	10.00	20	.01	.00	.01	5.	1.02	11.00	70	.16	.12	.05	415.
1.01	10.30	21	.01	.00	.01	5.	1.02	11.30	71	.16	.12	.05	423.
1.01	11.00	22	.01	.00	.01	5.	1.02	12.00	72	.16	.12	.05	429.
1.01	11.30	23	.01	.00	.01	5.	1.02	12.30	73	.99	.94	.05	514.
1.01	12.00	24	.01	.00	.01	5.	1.02	13.00	74	.99	.94	.05	807.
1.01	12.30	25	.06	.01	.05	5.	1.02	13.30	75	1.18	1.14	.05	1330.
1.01	13.00	26	.06	.01	.05	7.	1.02	14.00	76	1.18	1.14	.05	1977.
1.01	13.30	27	.07	.01	.06	10.	1.02	14.30	77	1.48	1.43	.05	2612.
1.01	14.00	28	.07	.01	.06	14.	1.02	15.00	78	1.48	1.43	.05	3200.
1.01	14.30	29	.09	.01	.08	19.	1.02	15.30	79	1.80	1.75	.05	3774.
1.01	15.00	30	.09	.01	.08	21.	1.02	16.00	80	5.69	5.65	.04	4737.
1.01	15.30	31	.11	.01	.10	25.	1.02	16.30	81	1.38	1.33	.05	6269.
1.01	16.00	32	.34	.07	.27	34.	1.02	17.00	82	1.38	1.33	.05	7564.
1.01	16.30	33	.68	.64	.05	55.	1.02	17.30	83	1.08	1.04	.05	8006.
1.01	17.00	34	.68	.64	.05	83.	1.02	18.00	84	1.08	1.04	.05	7437.
1.01	17.30	35	.97	.92	.05	106.	1.02	18.30	85	.09	.04	.05	6442.
1.01	18.00	36	.97	.92	.05	113.	1.02	19.00	86	.09	.04	.05	5375.
1.01	18.30	37	.01	.00	.00	107.	1.02	19.30	87	.09	.04	.05	4231.
1.01	19.00	38	.01	.00	.00	93.	1.02	20.00	88	.09	.04	.05	3351.
1.01	19.30	39	.01	.00	.00	74.	1.02	20.30	89	.09	.04	.05	2792.
1.01	20.00	40	.01	.00	.00	55.	1.02	21.00	90	.09	.04	.05	1880.
1.01	20.30	41	.01	.00	.00	40.	1.02	21.30	91	.09	.04	.05	1240.
1.01	21.00	42	.01	.00	.00	29.	1.02	22.00	92	.09	.04	.05	926.
1.01	21.30	43	.01	.00	.00	22.	1.02	22.30	93	.09	.04	.05	788.
1.01	22.00	44	.01	.00	.00	16.	1.02	23.00	94	.09	.04	.05	735.
1.01	22.30	45	.01	.00	.00	12.	1.02	23.30	95	.09	.04	.05	725.
1.01	23.00	46	.01	.00	.00	11.	1.03	0.00	96	.09	.04	.05	696.
1.01	23.30	47	.01	.00	.00	11.	1.03	.30	97	0.00	0.00	0.00	669.
1.02	0.00	48	.01	.00	.00	10.	1.03	1.00	98	0.00	0.00	0.00	642.
1.02	.30	49	.06	.01	.05	10.	1.03	1.30	99	0.00	0.00	0.00	617.
1.02	1.00	50	.04	.01	.05	10.	1.03	2.00	100	0.00	0.00	0.00	592.
										SUM	24.82	21.51	3.30	84090.
											(630.)	(546.)	(84.)	(2381.16)

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
	CFS	8006.	5217.	1723.	838.	83795.
	CMS	227.	148.	49.	24.	2373.
	INCHES		16.45	21.73	22.02	22.02
	MM		417.83	551.91	559.29	559.29
	AC-FT		2587.	3417.	3463.	3463.
	THOUS CU M		3191.	4215.	4271.	4271.

CMS	227.	148.	49.	24.	2373.
INCHES		16.45	21.73	22.02	22.02
MM		417.83	551.91	559.29	559.29
AC-FT		2587.	3417.	3463.	3463.
THOUS CU M		3191.	4215.	4271.	4271.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	4.	4.	4.	4.	5.	5.
5.	5.	5.	5.	5.	7.	10.	14.	18.	21.
25.	34.	55.	83.	106.	113.	107.	93.	74.	55.
40.	29.	22.	16.	12.	11.	11.	10.	10.	10.
17.	26.	33.	39.	43.	45.	47.	49.	50.	50.
61.	93.	160.	232.	293.	336.	367.	388.	404.	415.
423.	429.	514.	807.	1330.	1977.	2612.	3200.	3774.	4737.
6229.	7564.	8006.	7437.	6442.	5375.	4231.	3151.	2292.	1680.
1240.	926.	786.	755.	725.	696.	669.	642.	617.	592.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8006.	5217.	1723.	838.	83795.
CMS	227.	148.	49.	24.	2373.
INCHES		16.45	21.73	22.02	22.02
MM		417.83	551.91	559.29	559.29
AC-FT		2587.	3417.	3463.	3463.
THOUS CU M		3191.	4215.	4271.	4271.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	3.	3.	3.	4.
4.	4.	4.	4.	5.	8.	10.	13.	13.	16.
18.	25.	41.	62.	79.	85.	80.	70.	55.	41.
30.	22.	16.	12.	9.	8.	8.	8.	7.	7.
13.	19.	25.	29.	32.	34.	36.	37.	37.	38.
46.	73.	120.	174.	220.	252.	275.	291.	303.	311.
317.	321.	386.	605.	997.	1483.	1959.	2400.	2831.	3553.
4672.	5673.	6004.	5578.	4832.	4031.	3174.	2363.	1719.	1260.
930.	694.	590.	566.	544.	522.	502.	482.	462.	444.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6004.	3913.	1292.	628.	62846.
CMS	170.	111.	37.	18.	1780.
INCHES		12.34	16.30	16.51	16.51
MM		313.37	413.95	419.47	419.47
AC-FT		1940.	2563.	2597.	2597.
THOUS CU M		2393.	3161.	3203.	3203.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

1.	1.	1.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	5.	7.	9.	11.
12.	17.	28.	42.	53.	57.	54.	46.	37.	28.
20.	15.	11.	8.	6.	5.	5.	5.	5.	5.
9.	13.	17.	19.	21.	23.	24.	24.	25.	25.
31.	49.	80.	116.	146.	168.	183.	194.	202.	208.

Sheet 10 of 21

211.	214.	257.	403.	665.	989.	1306.	1600.	1887.	2369.
3115.	3782.	4003.	3719.	3221.	2688.	2116.	1576.	1146.	840.
620.	463.	393.	378.	363.	348.	334.	321.	308.	296.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4003.	2606.	861.	419.	41897.
CMS	113.	74.	24.	12.	1186.
INCHES		8.22	10.86	11.01	11.01
MM		208.91	275.95	279.65	279.65
AC-FT		1293.	1708.	1731.	1731.

211.	214.	257.	403.	665.	989.	1306.	1600.	1887.	2369.
3115.	3782.	4003.	3719.	3221.	2688.	2116.	1576.	1146.	840.
620.	463.	393.	378.	363.	348.	334.	321.	308.	296.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4003.	2608.	861.	419.	41897.
CMS	113.	74.	24.	12.	1186.
INCHES		8.22	10.86	11.01	11.01
MM		208.91	275.95	279.65	279.65
AC-FT		1293.	1708.	1731.	1731.
THOUS CU M		1595.	2107.	2136.	2136.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	3.	3.	4.	5.
6.	8.	14.	21.	26.	28.	27.	23.	18.	14.
10.	7.	5.	4.	3.	3.	3.	3.	2.	2.
4.	6.	8.	10.	11.	11.	12.	12.	12.	13.
15.	24.	40.	58.	73.	84.	92.	97.	101.	104.
106.	107.	129.	202.	332.	494.	653.	800.	944.	1184.
1557.	1891.	2001.	1859.	1611.	1344.	1058.	788.	573.	420.
310.	231.	197.	189.	181.	174.	167.	161.	154.	148.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2001.	1304.	431.	209.	20949.
CMS	57.	37.	12.	6.	593.
INCHES		4.11	5.43	5.50	5.50
MM		104.46	137.98	139.82	139.82
AC-FT		647.	854.	866.	866.
THOUS CU M		798.	1054.	1068.	1068.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

2 ROUTE THROUGH LAKE

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	920.	-1

STAGE	587.00	588.00	589.00	590.00	591.00	592.30	594.00	597.00
FLOW	0.00	18.00	50.80	97.50	174.20	309.70	529.70	1010.40
CAPACITY=	920.	1370.	1822.	2469.	4003.			
ELEVATION=	587.	590.	592.	595.	600.			

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
587.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID

CREL	SPWID	COGW	EXPW	ELEVL	COGL	CAREA	EXPL
587.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COGD	EXPD	DAMWID
592.3	3.1	1.5	204.

STATION 2, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	1.	2.	2.	3.	3.	4.	4.	4.
4.	5.	5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	6.	6.	6.	6.	6.	7.
7.	7.	8.	9.	10.	11.	13.	15.	17.	19.
23.	27.	31.	36.	45.	64.	92.	136.	195.	283.
726.	1820.	3199.	4209.	4820.	5070.	5009.	4707.	4264.	3772.
3245.	2714.	2282.	1949.	1699.	1505.	1349.	1223.	1119.	1031.

STORAGE

920.	920.	920.	920.	921.	921.	921.	921.	921.	921.
921.	922.	922.	922.	922.	922.	922.	922.	923.	923.
923.	923.	923.	923.	924.	924.	924.	925.	925.	926.
927.	928.	930.	933.	937.	941.	945.	949.	953.	955.
957.	958.	959.	960.	960.	960.	961.	961.	961.	961.
962.	962.	963.	965.	966.	968.	969.	971.	973.	975.
977.	980.	985.	992.	1003.	1015.	1029.	1044.	1060.	1076.
1093.	1109.	1128.	1154.	1196.	1262.	1354.	1469.	1606.	1772.
1978.	2210.	2428.	2594.	2695.	2734.	2725.	2676.	2604.	2520.
2435.	2357.	2289.	2233.	2188.	2152.	2121.	2095.	2072.	2053.

STAGE

587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
587.0	587.1	587.1	587.1	587.1	587.1	587.2	587.2	587.2	587.2
587.2	587.3	587.3	587.3	587.3	587.3	587.3	587.3	587.3	587.3
587.3	587.3	587.3	587.3	587.3	587.3	587.3	587.3	587.4	587.4
587.4	587.4	587.4	587.5	587.6	587.6	587.7	587.8	587.9	588.0
588.2	588.3	588.4	588.6	588.8	589.3	589.9	590.5	591.2	592.0
593.0	593.9	594.8	595.4	595.7	595.9	595.8	595.7	595.4	595.2
594.9	594.5	594.2	594.0	593.8	593.7	593.5	593.4	593.3	593.3

PEAK OUTFLOW IS 5070. AT TIME 43.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5070.	3765.	1173.	564.	56380.
CMS	144.	107.	33.	16.	1596.
INCHES		11.87	14.79	14.82	14.82
MM		301.52	375.73	376.31	376.31
AC-FT		1867.	2326.	2330.	2330.
THOUS CU M		2303.	2869.	2874.	2874.

STATION 2, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.

STATION 2, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	2.	2.	3.	3.	3.
3.	3.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	5.	5.	5.
5.	5.	6.	7.	7.	9.	10.	11.	13.	14.
16.	17.	19.	24.	31.	41.	59.	86.	124.	173.
256.	532.	1362.	2276.	2966.	3332.	3401.	3240.	2943.	2594.
2240.	1933.	1668.	1455.	1287.	1153.	1043.	952.	876.	811.

STORAGE

920.	920.	920.	920.	920.	921.	921.	921.	921.	921.
921.	921.	921.	921.	921.	922.	922.	922.	922.	922.
922.	922.	922.	923.	923.	923.	923.	923.	924.	925.
925.	926.	927.	930.	932.	936.	939.	942.	945.	946.
948.	947.	949.	950.	950.	950.	950.	951.	951.	951.
951.	952.	952.	953.	954.	956.	957.	958.	960.	961.
962.	965.	968.	974.	98[illegible].	992.	1002.	1013.	1025.	1037.
1050.	1062.	1076.	1096.	1128.	1177.	1246.	1333.	1437.	1563.
1724.	1921.	2123.	2288.	2394.	2447.	2457.	2434.	2391.	2339.
2283.	2230.	2183.	2142.	2108.	2080.	2056.	2035.	2016.	2000.

STAGE

587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
587.0	587.0	587.0	587.1	587.1	587.1	587.1	587.1	587.2	587.2
587.2	587.2	587.2	587.2	587.2	587.2	587.2	587.2	587.2	587.2
587.2	587.2	587.2	587.2	587.2	587.2	587.2	587.3	587.3	587.3
587.3	587.3	587.3	587.4	587.4	587.5	587.5	587.6	587.7	587.8
587.9	587.9	588.0	588.2	588.4	588.7	589.2	589.8	590.3	591.0
591.8	592.7	593.6	594.2	594.7	594.9	594.9	594.9	594.7	594.5
594.2	594.0	593.8	593.6	593.5	593.4	593.3	593.2	593.1	593.0

PEAK OUTFLOW IS 3401. AT TIME 43.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3401.	2448.	763.	367.	36703.
CMS	96.	69.	22.	10.	1039.
INCHES		7.72	9.63	9.64	9.64
MM		196.11	244.54	244.98	244.98
AC-FT		1214.	1514.	1517.	1517.
THOUS CU M		1498.	1867.	1871.	1871.

STATION 2, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	4.	4.	4.	5.	6.	7.	7.	8.	9.
10.	11.	12.	14.	17.	23.	33.	46.	65.	91.
132.	190.	270.	447.	843.	1193.	1414.	1496.	1470.	1370.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	4.	4.	4.	5.	6.	7.	7.	8.	9.
10.	11.	12.	14.	17.	23.	33.	46.	65.	91.
132.	190.	270.	447.	843.	1193.	1414.	1496.	1470.	1380.
1260.	1133.	1013.	912.	827.	757.	698.	647.	603.	565.

STORAGE

920.	920.	920.	920.	920.	920.	920.	921.	921.	921.
921.	921.	921.	921.	921.	921.	921.	921.	921.	921.
921.	922.	922.	922.	922.	922.	922.	922.	923.	923.
923.	924.	925.	926.	928.	930.	933.	935.	936.	938.
939.	939.	940.	940.	940.	940.	940.	940.	941.	941.
941.	941.	942.	942.	943.	944.	945.	945.	946.	947.
948.	950.	952.	956.	961.	968.	975.	982.	990.	998.
1006.	1015.	1024.	1037.	1059.	1092.	1138.	1197.	1266.	1351.
1460.	1596.	1747.	1892.	2008.	2088.	2134.	2150.	2145.	2127.
2103.	2076.	2049.	2025.	2004.	1986.	1970.	1956.	1943.	1932.

STAGE

587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
587.0	587.0	587.0	587.0	587.1	587.1	587.1	587.1	587.1	587.1
587.1	587.1	587.1	587.1	587.1	587.1	587.1	587.1	587.1	587.1
587.1	587.1	587.1	587.1	587.2	587.2	587.2	587.2	587.2	587.2
587.2	587.2	587.2	587.2	587.3	587.3	587.4	587.4	587.5	587.5
587.6	587.6	587.7	587.8	587.9	588.1	588.5	589.2	589.3	589.9
590.5	591.1	591.9	592.6	593.1	593.4	593.6	593.7	593.6	593.6
593.5	593.4	593.2	593.1	593.1	593.0	592.9	592.9	592.8	592.8

PEAK OUTFLOW IS 1496. AT TIME 44.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1496.	1135.	362.	174.	17416.
CMS	42.	32.	10.	5.	493.
INCHES		3.58	4.56	4.58	4.58
MM		90.95	115.95	116.24	116.24
AC-FT		563.	718.	720.	720.
THOUS CU M		695.	885.	888.	888.

STATION 2, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	2.	2.	2.
2.	2.	2.	2.	2.	3.	3.	4.	4.	5.
5.	6.	6.	7.	8.	10.	13.	17.	23.	33.

45.	63.	87.	114.	140.	162.	180.	196.	207.	213.
216.	217.	217.	217.	216.	215.	214.	213.	212.	211.

STORAGE

920.	920.	920.	920.	920.	920.	920.	920.	920.	920.
920.	920.	920.	920.	920.	921.	921.	921.	921.	921.
921.	921.	921.	921.	921.	921.	921.	921.	921.	922.
922.	922.	922.	923.	924.	925.	926.	927.	928.	929.

	45.	63.	87.	114.	140.	162.	180.	196.	207.	213.
	216.	217.	217.	217.	216.	215.	214.	213.	212.	211.

STORAGE

	920.	920.	920.	920.	920.	920.	920.	920.	920.	920.
	920.	920.	920.	920.	920.	921.	921.	921.	921.	921.
	921.	921.	921.	921.	921.	921.	921.	921.	921.	922.
	922.	922.	922.	923.	924.	925.	926.	927.	928.	929.
	929.	930.	930.	930.	930.	930.	930.	930.	930.	930.
	930.	931.	931.	931.	931.	932.	932.	933.	933.	934.
	934.	935.	936.	938.	941.	944.	947.	951.	955.	959.
	963.	967.	972.	979.	989.	1006.	1029.	1059.	1094.	1137.
	1192.	1261.	1338.	1414.	1480.	1535.	1577.	1608.	1627.	1639.
	1646.	1648.	1648.	1647.	1645.	1644.	1642.	1640.	1638.	1635.

STAGE

	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0
	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.1	587.1
	587.1	587.1	587.1	587.1	587.1	587.1	587.1	587.1	587.1	587.1
	587.1	587.1	587.1	587.1	587.1	587.1	587.1	587.1	587.1	587.1
	587.1	587.1	587.1	587.1	587.1	587.2	587.2	587.2	587.2	587.3
	587.3	587.3	587.3	587.4	587.5	587.6	587.7	587.9	588.2	588.4
	588.8	589.3	589.8	590.2	590.6	590.8	591.1	591.2	591.3	591.4
	591.4	591.4	591.4	591.4	591.4	591.4	591.4	591.4	591.4	591.3

PEAK OUTFLOW IS 217. AT TIME 46.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	217.	213.	75.	36.	3642.
CMS	6.	6.	2.	1.	103.
INCHES		.67	.95	.96	.96
MM		17.09	24.16	24.31	24.31
AC-FT		106.	150.	150.	150.
THOUS CU M		131.	185.	186.	186.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

3 CHANNEL ROUTE D/S OF DAM

ISTAQ	ICOMP	ICON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0350	.0170	.0350	566.0	600.0	1000.	.01200

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0350	.0170	.0350	568.0	600.0	1000.	.01200

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 600.00 250.00 580.00 375.00 575.00 377.00 568.00 393.00 568.00
395.00 575.00 645.00 580.00 1395.00 600.00

STORAGE	0.00	.64	1.39	2.02	2.77	5.28	12.62	24.84	41.32	61.07
	84.07	110.34	139.85	172.63	208.65	247.94	290.48	336.28	385.33	437.64
OUTFLOW	0.00	337.21	1006.05	1985.02	2932.97	4646.96	8326.33	15160.83	26521.99	42338.60
	62944.34	88757.78	120192.05	157651.06	201528.62	252208.62	310065.56	375465.16	448765.03	530315.22
STAGE	568.00	569.68	571.37	573.05	574.74	576.42	578.11	579.79	581.47	583.16
	584.84	586.53	588.21	589.89	591.58	593.26	594.95	596.63	598.32	600.00
FLOW	0.00	337.21	1006.05	1985.02	2932.97	4646.96	8326.33	15160.83	26521.99	42338.60
	62944.34	88757.78	120192.05	157651.06	201528.62	252208.62	310065.56	375465.16	448765.03	530315.22

STATION 3, PLAN 1, RTIO 1

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	1.
1.	1.	1.	2.	2.	2.	3.	4.	4.	4.
4.	5.	5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	6.	6.	6.	6.	7.
7.	7.	8.	9.	10.	11.	13.	15.	17.	19.
23.	26.	30.	36.	45.	63.	91.	134.	192.	278.
707.	1793.	3167.	4168.	4811.	5055.	5026.	4719.	4285.	3786.
3267.	2723.	2289.	1954.	1704.	1509.	1352.	1225.	1120.	1033.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	2.	3.	5.	6.	6.	6.	5.	5.	4.
3.	3.	2.	2.	2.	2.	2.	1.	1.	1.

STAGE

568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.1	568.1	568.1	568.1	568.1
568.1	568.1	568.2	568.2	568.2	568.3	568.5	568.7	569.0	569.4
570.6	572.9	575.0	576.0	576.5	576.6	576.6	576.5	576.1	575.6

Sheet 16 of 21

575.1	574.4	573.7	573.2	572.7	572.3	572.0	571.8	571.6	571.4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5055.	3764.	1172.	563.	56347.
CMS	143.	107.	33.	16.	1596.
INCHES		11.87	14.78	14.81	14.81
MM		301.50	375.51	376.09	376.09
AC-FT		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]

Sheet 16 of 21

575.1	574.4	573.7	573.2	572.7	572.3	572.0	571.8	571.6	571.4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5055.	3764.	1172.	563.	56347.
CMS	143.	107.	33.	16.	1596.
INCHES		11.87	14.78	14.81	14.81
MM		301.50	375.51	376.09	376.09
AC-FT		1867.	2325.	2328.	2328.
THOUS CU M		2302.	2868.	2872.	2872.

MAXIMUM STORAGE = 6.

MAXIMUM STAGE IS 576.6

STATION 3, PLAN 1, RTIO 2

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	2.	2.	3.	3.	3.
3.	3.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	5.	5.	5.
5.	5.	6.	6.	7.	9.	10.	11.	13.	14.
15.	17.	19.	23.	30.	41.	56.	85.	122.	170.
253.	521.	1337.	2265.	2951.	3320.	3406.	3246.	2957.	2593.
2261.	1932.	1679.	1453.	1296.	1150.	1050.	950.	881.	809.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	2.	2.	3.	3.	3.	3.	3.	3.
2.	2.	2.	2.	2.	1.	1.	1.	1.	1.

STAGE

568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.1	568.1	568.1
568.1	568.1	568.1	568.1	568.2	568.2	568.3	568.4	568.6	568.9
569.3	570.1	572.0	573.7	574.8	575.1	575.2	575.0	574.8	574.2
573.7	573.1	572.7	572.2	571.9	571.6	571.5	571.2	571.1	570.9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3406.	2448.	763.	367.	36676.
CMS	96.	69.	22.	10.	1039.
INCHES		7.72	9.62	9.64	9.64
MM		196.11	244.36	244.80	244.80

Sheet 17 of 21

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
AC-FT		1214.	1513.	1516.	1516.
THOUS CU M		1498.	1866.	1869.	1869.

MAXIMUM STORAGE = 3.

AC-FT	1214.	1513.	1516.		1516.
THOUS CU M	1498.	1866.	1869.		1869.

MAXIMUM STORAGE = 3.

MAXIMUM STAGE IS 575.2

STATION 3, PLAN 1, RTIO 3

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	4.	4.	4.	5.	6.	7.	7.	8.	9.
10.	11.	12.	14.	16.	22.	32.	45.	64.	90.
130.	187.	266.	439.	831.	1189.	1409.	1497.	1470.	1384.
1262.	1137.	1014.	915.	828.	760.	698.	649.	603.	567.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	2.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.

STAGE

568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.1	568.1	568.1	568.1	568.1	568.1	568.2	568.2	568.3	568.5
568.6	568.9	569.3	569.9	570.9	571.7	572.1	572.3	572.3	572.1
571.9	571.6	571.4	571.1	570.9	570.7	570.6	570.5	570.4	570.3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1497.	1136.	361.	174.	17395.
CMS	42.	32.	10.	5.	493.
INCHES		3.58	4.56	4.57	4.57
MM		90.97	115.81	116.10	116.10
AC-FT		563.	717.	719.	719.
THOUS CU M		695.	884.	887.	887.

MAXIMUM STORAGE = 2.

Sheet 18 of 21

MAXIMUM STAGE IS 572.3

STATION 3, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Sheet 18 of 21

MAXIMUM STAGE IS 572.3

STATION 3, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	2.	2.	2.
2.	2.	2.	2.	2.	3.	3.	4.	4.	5.
5.	6.	6.	7.	8.	10.	13.	16.	23.	32.
44.	62.	86.	113.	139.	161.	179.	195.	206.	213.
216.	217.	217.	217.	216.	215.	214.	213.	212.	211.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0	568.0
568.0	568.0	568.0	568.0	568.0	568.1	568.1	568.1	568.1	568.2
568.2	568.3	568.4	568.6	568.7	568.8	568.9	569.0	569.0	569.1
569.1	569.1	569.1	569.1	569.1	569.1	569.1	569.1	569.1	569.1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	217.	213.	75.	36.	3632.
CMS	6.	6.	2.	1.	103.
INCHES		.67	.95	.95	.95
MM		17.09	24.10	24.24	24.24
AC-FT		106.	149.	150.	150.
THOUS CU M		130.	184.	185.	185.

MAXIMUM STORAGE = 0.

MAXIMUM STAGE IS 569.1

********** ********** ********** ********** **********

Sheet 19 of 21

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	587.00	587.00	592.30
STORAGE	920.	920.	1822.
OUTFLOW	0.	0.	310.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	595.86	3.56	2734.	5070.	10.00	43.00	0.00
.75	594.95	2.65	2457.	3401.	9.50	43.50	0.00
.50	593.67	1.37	2150.	1496.	8.50	44.00	0.00
.25	591.41	0.00	1648.	217.	0.00	46.00	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	5055.	576.6	43.00
.75	3406.	575.2	43.50
.50	1497.	572.3	44.00
.25	217.	569.1	46.50

STABILITY ANALYSIS

APPENDIX E

TAMS

Job No. 1579-13 Sheet 1 of 24
Project NYS Dam Inspection Date 5-27-81
Subject Kirk Lake Dam - Stability Analysis By JF
Ch'k. by

Assumptions

1) The unit weights assumed were as follows: Masonry 165pcf, Concrete 150pcf, Earth fill (Sat.) 65pcf

2) Stability and conditions determined in accordance with Corps of Engineers Phase I Guidelines

3) The Concrete slab on the approach channel is not considered an integral part of the structure. The earthfill beneath the slab is considered to be completely pervious and saturated. Therefore total hydrostatic head is considered to be acting at the base of the structure.

4) Angle of internal resistance of Till Soil foundation is considered to be 35°, C = 200 psf based on observations and engineering judgement. Ka assumed for backfill, based on $\phi = 35°$.

5) Dam site is in Seismic Zone 2.

6) Ice Load of 5K/ft² acting at 4ft from the top of the spillway section.

Loading Conditions

I) Normal Load; Lake at spillway crest, Elev. 587.
No Ice Load.

II) Normal Load; Lake at spillway crest; Elev 587.
With Ice Load

III) Unusual Load; Lake at 1/2 PMF Elev. 593.67

IV) Extreme Load; Lake at PMF Elev. 595.86

V) Unusual Load; Lake at Elev. 587 with addition of Ouse earthquake force.

TAMS

Job No. 1579-12 Sheet 2 of 24
Project NYS Dam Insp. Date 5-27-81
Subject Kirk Lake Dam By JF
Ch'k. by

STABILITY CRITERIA (see assumption # 2)

a) Overturning Criteria Loading Cases I, ~~II~~, III, ~~IV~~ - Resultant must fall within the middle 1/3 of the base.

- Loading Case II resultant must fall within the base

b) Sliding Criteria - Cases I through IV

Shear friction factor of Safety ≥ 3
(SFFS)

Case V
Shear friction factor of Safety ≥ 1.5
(SFFS)

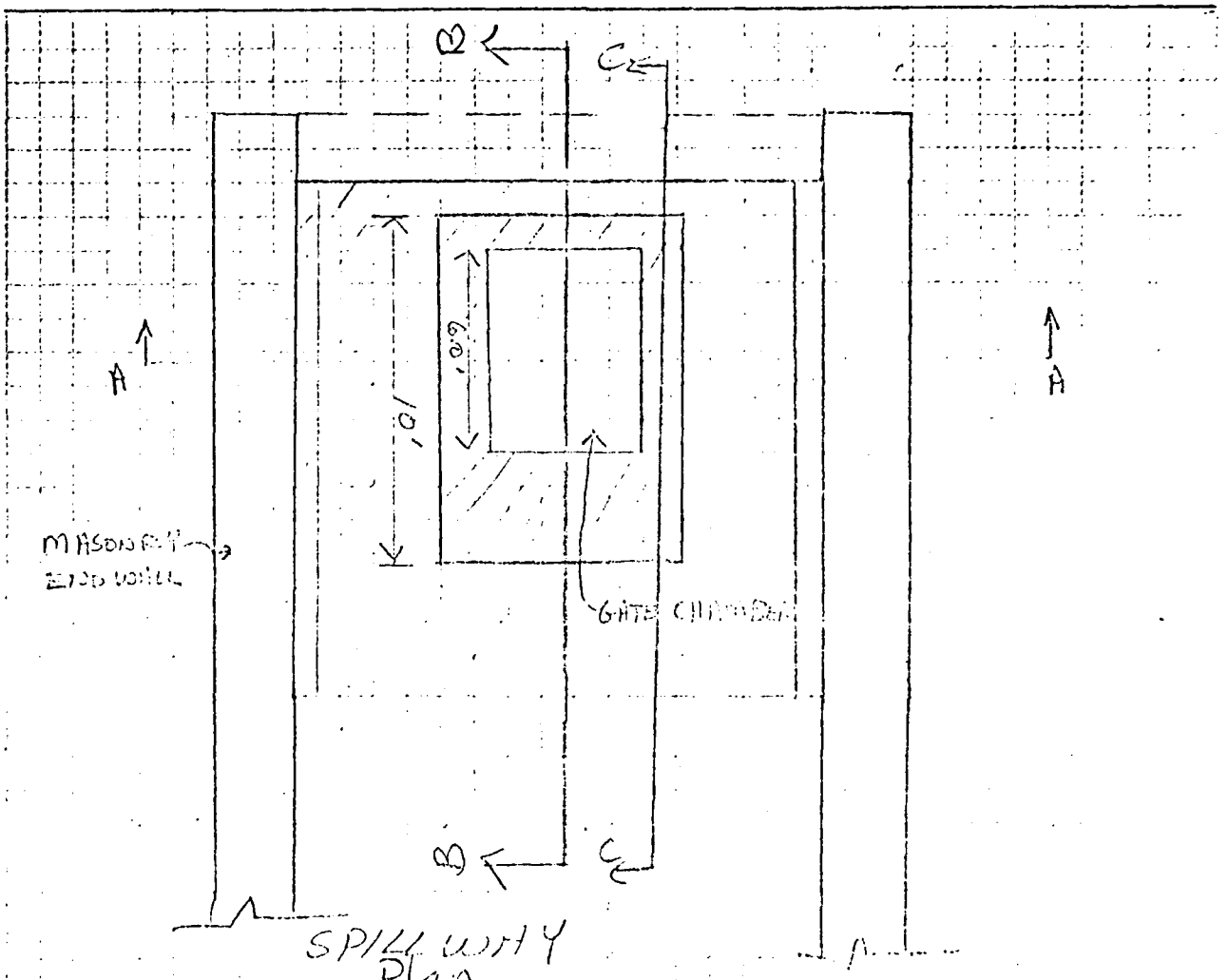
TAMS

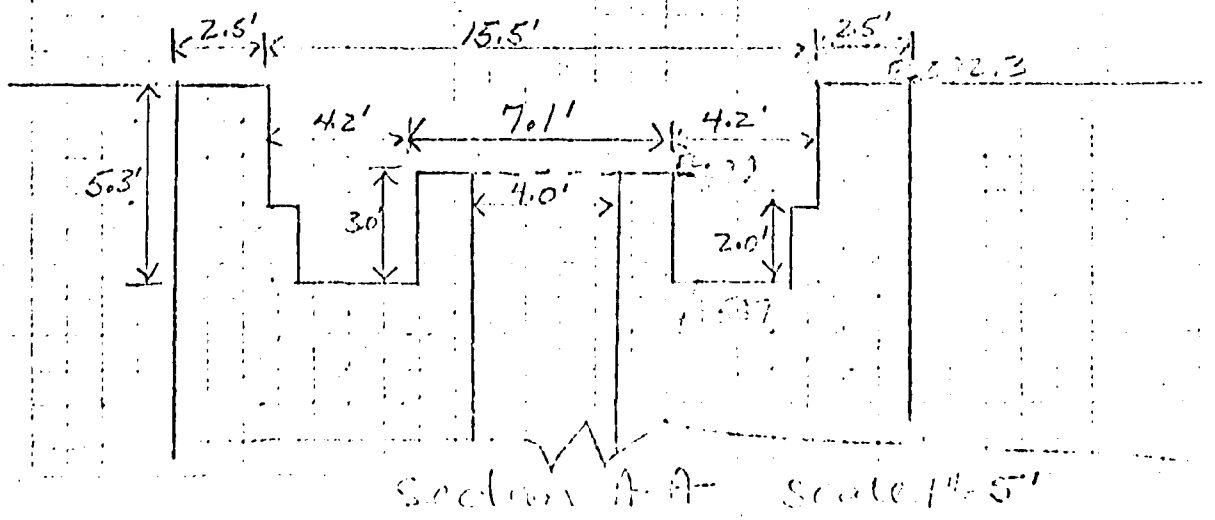
Job No. 1529-13 Sheet 3 of [illegible]

Project NYS DAM INSP Date

Subject KIRK LAKE DAM By

Ch'k. by

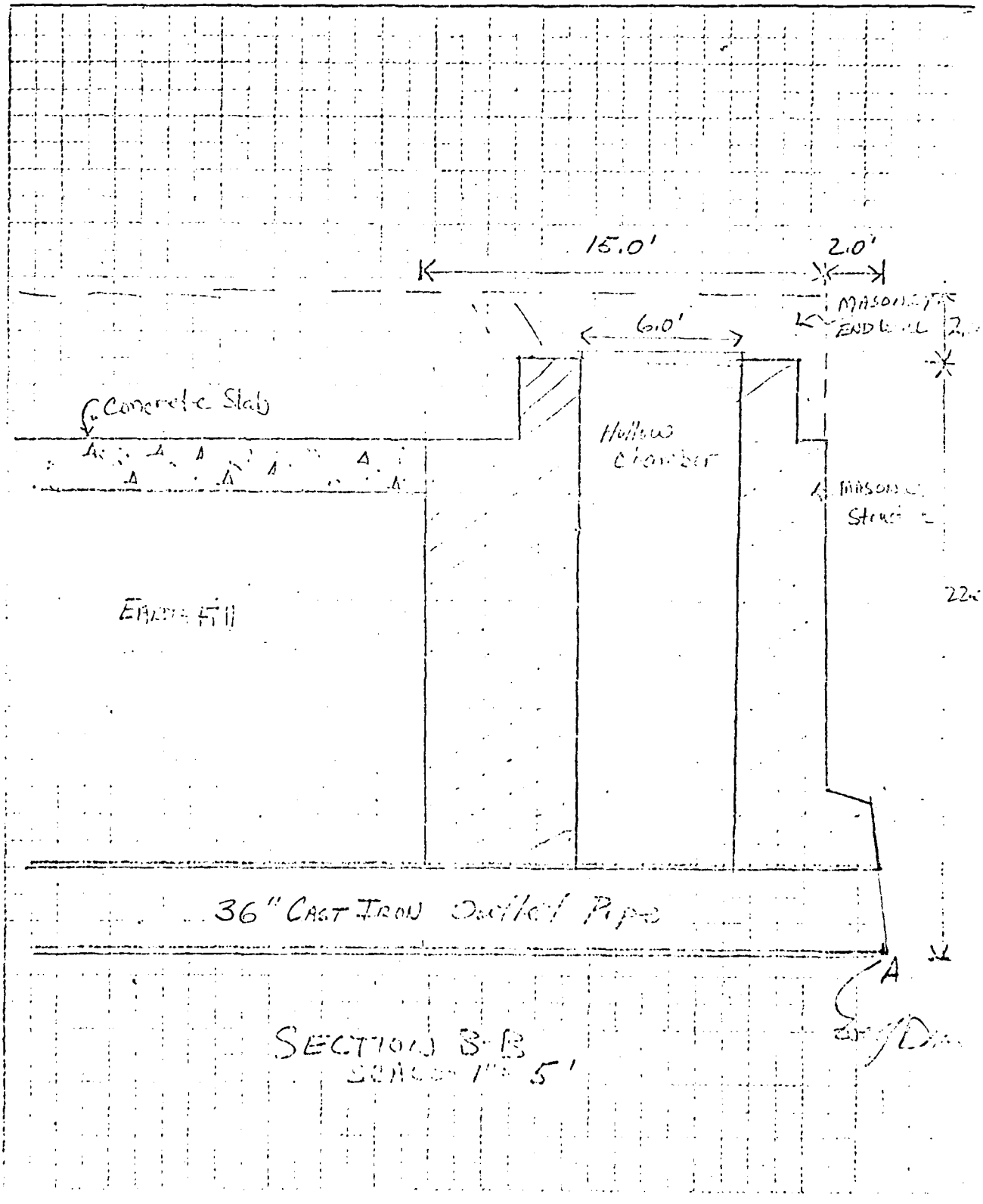




TAMS

Job No. 1579-13
Project NYS DAM INSPECTION
Subject KIRK LAKE DAM

Sheet 4 of 20
Date 6-9-81
By [illegible]
Ch'k. by



TAMS

Job No. [illegible] Sheet 5 of 24

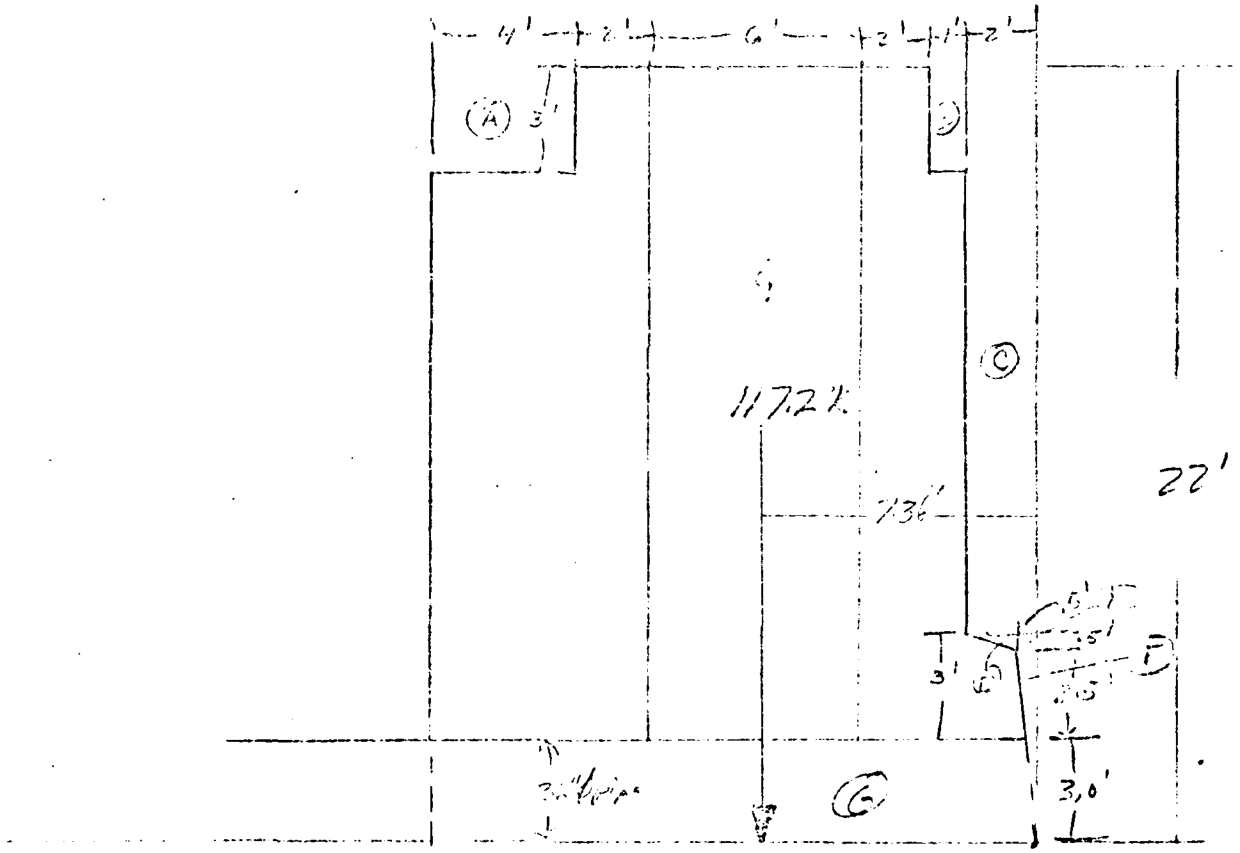
Project [illegible] Date 6-8-?

Subject [illegible] By [illegible]

Ch'k. by

Calculate total Mass of Spillway Section

Section B-B- width 4feet



Total Mass of 17'×22'×4.0' block = 17'×22'×165 pcf×4.0' = 246,840 K

Less Mass of lower block 4'×6'×19.0'×165 pcf = −75,?40 K

Mass of (A) 3'×4'×4.0×165 pcf = −7,920

Mass of (B) 3'×1'×4.0×165 pcf = −1,980

(C) [illegible] = −21,120

(D) [illegible] = −2,475

(E) [illegible] ×4×165 = −165

(F) ½([illegible])×165 = −.907

(G) [illegible] = −[illegible]

117.2?

TAMS

Job No. 1579-B | Sheet 6 of 24
Project [illegible] Dam Inspection | Date 6-9-81
Subject Kirk Lake Dam - [illegible] | By [illegible]
Ch'k. by

Find Overturning [illegible] Section B-B - symmetric about long. axis

[illegible] [illegible] [illegible] Neglecting [illegible] [illegible] [illegible] [illegible] weight [illegible] [illegible] [illegible]

249.5??
−117.??
127.64 × .5 = 64.82

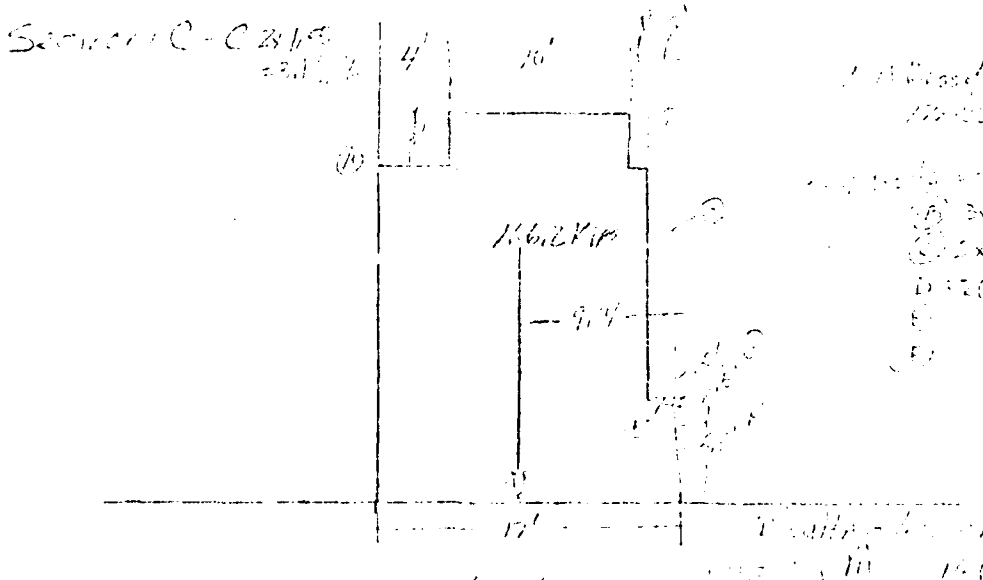
$M_1 + M_2 X + M_3 X^2 = 64.82$

7.92 + [illegible] X + [illegible] = 64.82

7.92 + 11 (X + 12.64 [illegible]) = 64.82
7.92 + 11.0X + 12.57 − [illegible] = 64.82

13.70X = 133.4
X = 9.74
[illegible] 7.36' [illegible] [illegible] D/S [illegible]

Section C-C 2.1



166.2 K

11.3X = 73.1
X = 7.38
[illegible] 9.6

TAMS

Job No. 1579-13 | Sheet 7 of 24
Project [illegible] | Date [illegible]
Subject [illegible] | By [illegible]
Ch'k. by

[illegible]

Total Mass 243' x 17' x [illegible] = 913.364 Kips

[illegible]

[illegible]

Total Mass [illegible] 913.[illegible] − [illegible] − 65.95 = 754.155 Kips

[illegible]

754.155K / 2 = [illegible]

377.077 = 52.727 X − [illegible]84 X

377.077 = 46.3[illegible] X

X = [illegible]

17 − [illegible] = [illegible]

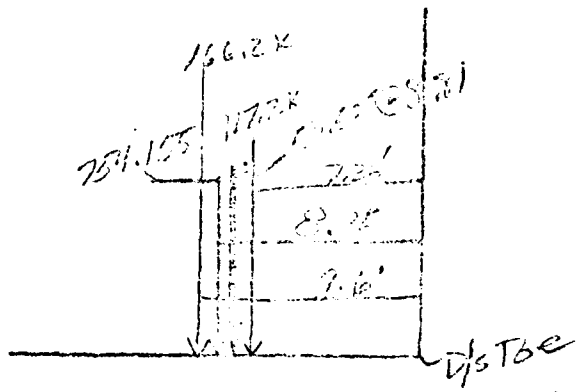
TAMS

Job No. 1529.12 Sheet 8 of 24
Project [illegible] Date [illegible]
Subject [illegible] By [illegible]
Ch'k. by

Average Mass / ft of spillway width

$$\frac{\Sigma M_{res}}{w} = \frac{117.2 + 166.2 + 254.1}{20.5'} = 50.6 \text{ kips/ft}$$

Location of Net Resultant



$$\Sigma M = (754.1 \times 3.1) + (166.2 \times 9.6) + (117.2 \times 7.3) = 9214.8 \text{ k-ft}$$

Eccentricity $\frac{M}{F} = \frac{9214.8}{1037.5 \text{ k}} = 8.88'$

Resultant M $M = 449.3$ k-ft

TAMS

Job No. 1279.13 Sheet 9 of 24

Project NYS Dam Inspection Date 6-2-81

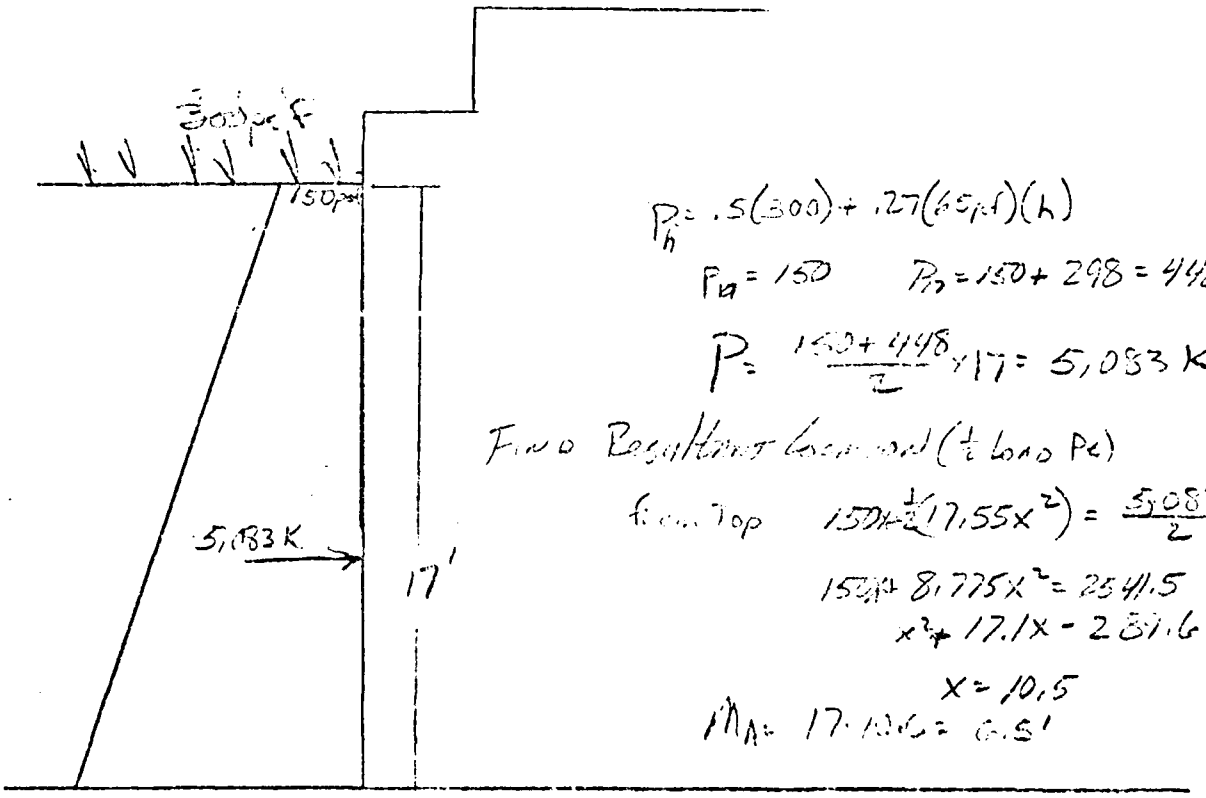
Subject Kirk Lake Dam - Sliding Analysis By JEW

Ch'k. by

Calculate
Active Earth pressure on wall

1) Consider Concrete Slab as a 300 psf surcharge
2) Neglect passive of Concrete and 36" pipe at end

γ_{sat} = 65 pcf Ka Coulomb $\phi = 35°$
Ka = .27



$P_h = .5(300) + .27(65pf)(h)$

$P_{ta} = 150$ $P_{tb} = 150 + 298 = 448$ psf

$P = \frac{150 + 448}{2} \times 17 = 5,083$ K

Find Resultant Location ($\frac{1}{2}$ load Pc)

from Top $150h + \frac{1}{2}(17.55x^2) = \frac{5083}{2}$

$150h + 8.775x^2 = 2541.5$

$x^2 + 17.1x - 289.6 = 0$

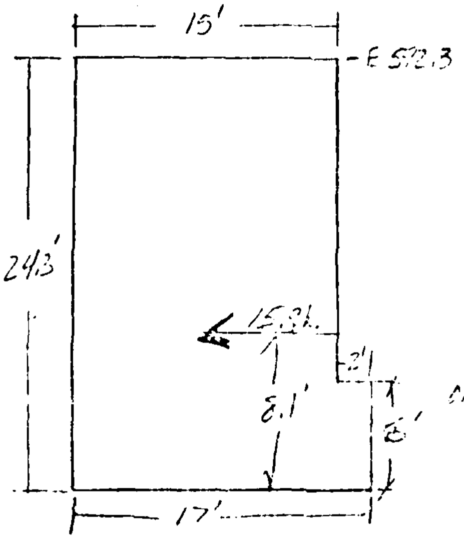
$x = 10.5$

$M_A = 17 - 10.5 = 6.5'$

$F_A = 5,083$ K

$M_O = 33.04$ Kft

Calculate Side Shear available on sides of spillway section



Earth Pressure Distribution on Side of Spillway Section
El @ 592.3 w/ Dam [illegible]
γ_{sub} = 62.6 pcf $K_o = 1 - \sin\phi$ = [illegible]
Assume triangular distribution

$p = K_o \gamma_s h = .43(62.6)h$

$P_T = \frac{1}{2} K_o \gamma_s h^2 =$
$h = 24.3$ $P_T = 7.95$ k/ft

[illegible] P_T 7.95k × 15.5 = 123.2 kips
Both sides × 2 × 123.2 = 246.4 kips
Distributed per unit width of spillway

$P_H = \frac{246.4k}{15.5ft} = 15.9$ kips
@ 1/3 ht $\frac{24.3}{3} = 8.1$ ft

Spillway section area
= 15 × 24.3 + 2 × 6 = 376.5 sf

Average length = $\frac{376.5}{24.3}$ = 15.5'

Friction factor = $\frac{2}{3}\tan\phi = \frac{2}{3}(\tan 35°)$
= .46

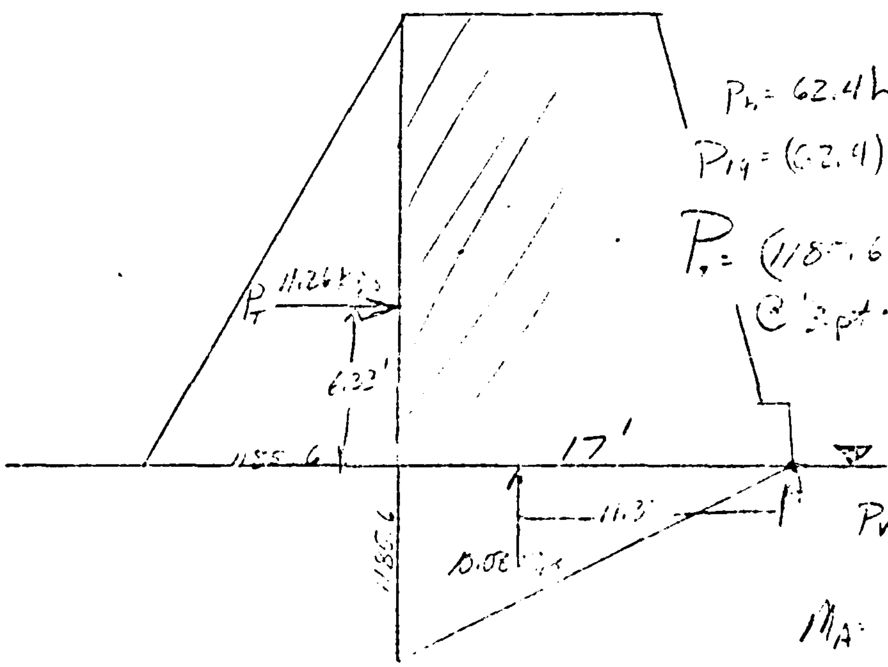
Unit width resistance $.46 P_H = F_H = 7.31$ kips
$M_R = 59.24$ kft

TAMS

Job No. 1579-13 Sheet 11 of 24
Project KYS DI Date 6-3-8[illegible]
Subject KLD - SA By [illegible]
Ch'k. by

Case I Hydrostatic Pressure WL @ 587'

1) H_2O pressure acts on 15.5' width of Spillway no pressure on 2½' training walls –



$P_h = 62.4h$

$P_{19} = (62.4)\,19 = 1185.6$

$P_T = (1185.6 \times 19)\,½ = 11.26\ K$

@ ⅓ pt = $\frac{19}{3} = 6.33'$

$M_1 = 71.3\ Kft$

$P_V = (1185.6 \times 17) \times ½ = 10.08\ Kips$

$M_A = 17 - ⅓ = 11.3'$

$M_1 = 113.9\ Kft$

Case II Ice-force Calculations
1' thick strip at Water Level Exerting 5,000 psf

$F_{ll} = 5000\ psf/ft$

$M_A = 18.5'$

$M = 18.5' \times 5000 k = 92.5\ Kft$

TAMS

Job No. 1579-13 Sheet 12 of 24

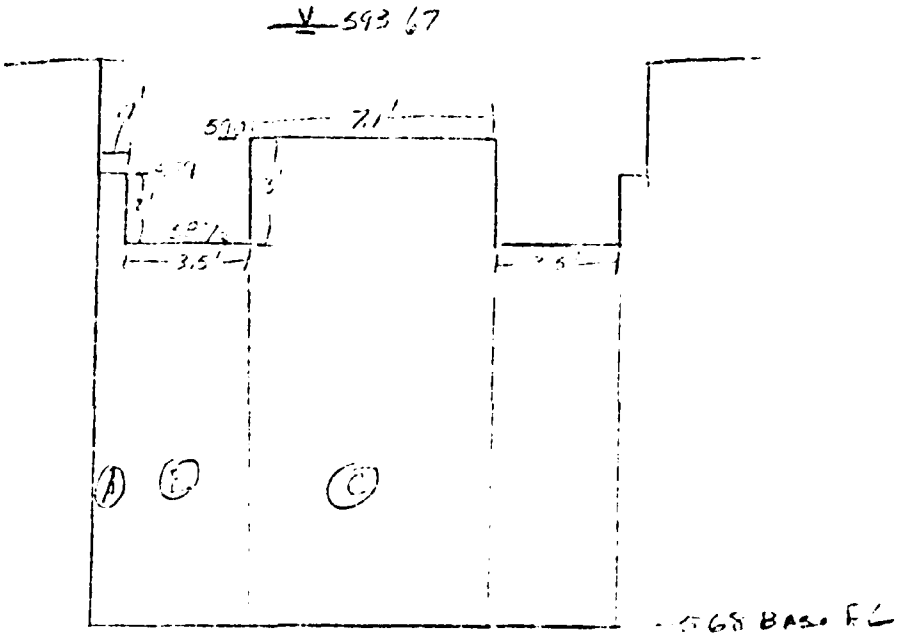
Project N45 OT Date 6-20-81

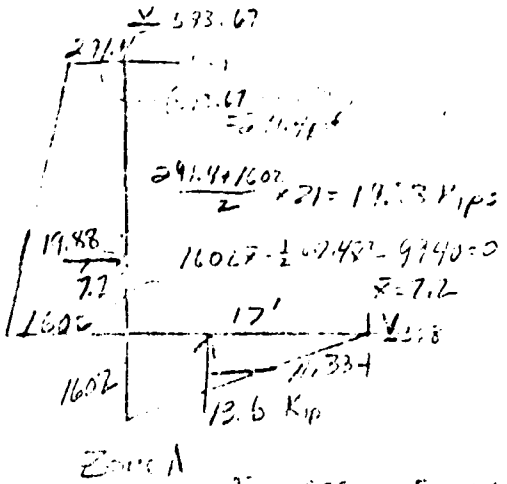
Subject KLD-SA By [illegible]

Ch'k. by

Case III ½PMF WL@ 593.67

FACE of DAM DOWNSTREAM

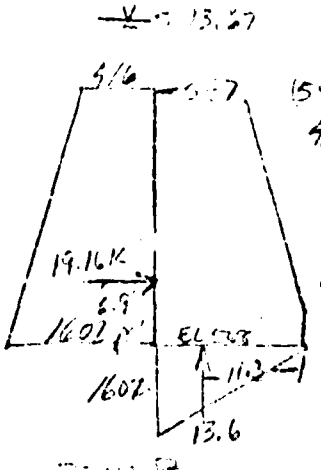




Zone A

V_{ft} = 11.88 K V_{ft} = 12.6 K

$\bar{x}$ = 7.2' $\bar{x}$ = 11.3'



Zone B

V_{ft} = 19.16K V_{ft} = 12.6K

$\bar{x}$ = 6.9' $\bar{x}$ = 11.3'

TAMS

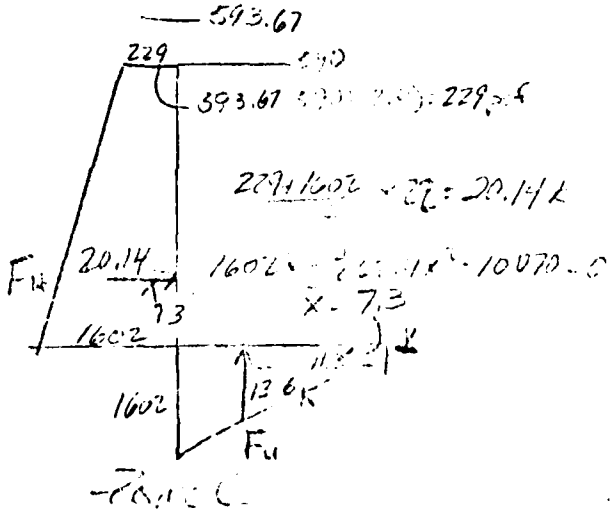
Job No. 1579.13 Sheet 13 of 24

Project 1145 Dam Inspection Date 6-8-91

Subject Kinkora Dam Spillway Analysis By JW

Ch'k. by

Case III Cont.



$F_H = 20.14$ k
$\bar{X}_H = 7.3'$
$F_u = 13.6$ k
$\bar{X}_u = 11.3'$

Calculate Axial Force / unit width & Axial Moment Arm

B	7.0	19.16	6.9	134.10	925.29	
C	7.1	20.14	7.3	142.99 / 307.92	1043.80 / 2169.46	

For 15.5' wide: $\bar{F} = 19.67$ kips

$\bar{M}_A = \frac{2169.46}{307.92} = 7.11'$

$\bar{F}_H = 19.67$ kips $\bar{M}_H = 139.9$ k-ft

$\bar{F}_u = 13.6$ kips $\bar{M}_u = 153.68$ k-ft

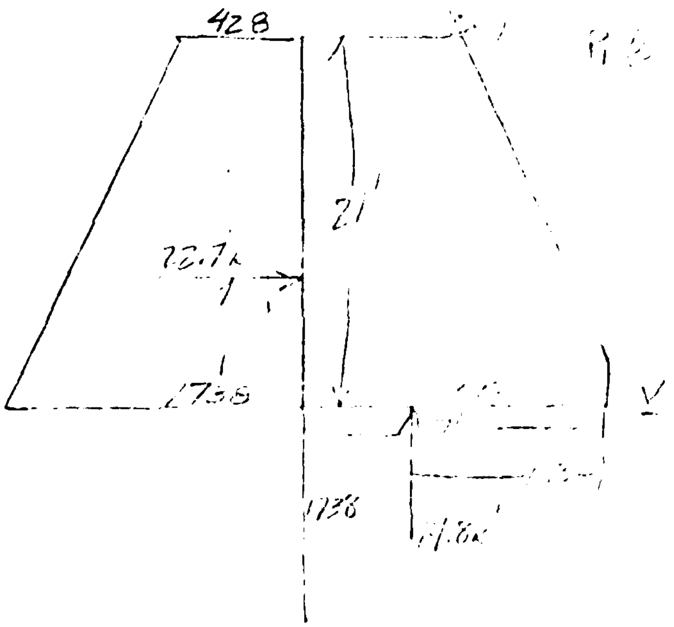
TAMS

Job No. 1572-13 Sheet 14 of 24
Project [illegible] Date [illegible]
Subject [illegible] By [illegible]
Ch'k. by

Case IV PMP W.L.@ 515.86

Same Face of Dam as Case III

Zone A ∓ 515.86



P @ [illegible] = 428 psf

T = (428+1738)/2 (21) = 22.7 ks

[illegible] (1738) [illegible] 11.371 [illegible]

x = 7.6'

F [illegible] = 11.8 ks

X [illegible] = 11.23'

T [illegible] .7 [illegible] x_H [illegible] 6'

M_H = 172.5 k-ft

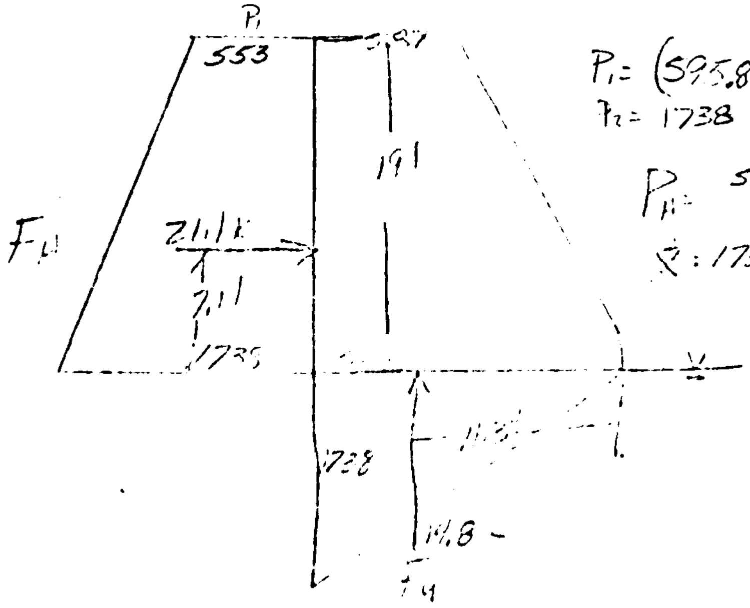
T_U = 11.8k x_U = 11.23'

M_U = 167.2 k-ft

TAMS

Job No. 1579-13 | Sheet 15 of 24
Project 1245 [illegible] | Date 6-5-81
Subject [illegible] | By [illegible]
Ch'k. by

[illegible] B — ▽ 595.86



$P_1 = (595.86 - 587)\,62.4 = 553$

$P_2 = 1738$ [illegible] A

$P_H = \frac{553 + 1738}{2} \times 9 = 21.8$ Kips

$\bar{x}: 1738x - \frac{1}{2}\,62.4x^2 - 10{,}882 = 0$

$\bar{x} = 7.2$

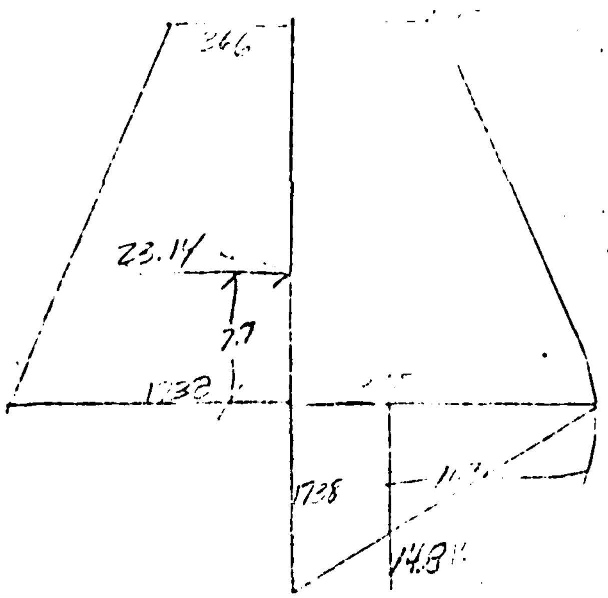
$F_H = 21.8$ K [illegible] $\bar{x} = 7.2'$

$M_H = 157.0$ [illegible]

$F_U = 14.8$ [illegible]

$M_U = 167.2$ [illegible]

[illegible] C — ▽ [illegible]



[illegible] 588.5 [illegible] = 366 [illegible]

$P_H = \frac{366 + 1738}{2}\,(22) = 23.14$ [illegible]

$\bar{x}$ [illegible] $1738 - \frac{1}{2}\,62.4x^2 - 11572 = 0$

$\bar{x} = 7.7'$

$F_H = 23.14K \quad \bar{x} = 7.7'$

$M_H = 178.2$ K-ft

$F_U = 14.8$ K $\bar{x}_U = 11.3'$

$M_U = 167.2$ K-ft

TAMS

Job No. 1571-13 Sheet 16 of 24
Project NYS Dam Inspection Date 6-8-81
Subject Kinderhook Lake Dam - Stability Analyses By JWA
Ch'k. by

Calculate Ave. Force / unit width + Eccentricity thereof

Case	Width	F_H	$\bar{x}_H$	F_{tot}	M_o
A	1.4'	22.7K	7.6'	31.8K	241.5 K-ft
B	7.0'	21.8K	7.2'	152.6K	1098.7 K-ft
C	7.1'	23.14K	7.7	164.3K	1265.1 K-ft
				348.7K	2605.3 K-ft

For 15.5' wide dam $\bar{F}_1 = \frac{348.7}{15.5} = 22.5$ K

$\bar{M}_1 = \frac{2605.3}{348.7} = 7.47'$

$\bar{F}_1 = 22.5$ K $\quad \bar{M}_1 = 168.1$ K-ft

$\bar{F}_2 = 1.8$ K $\quad \bar{M}_2 = 67.2$ K-ft

TAMS

Job No. 1579-13 | Sheet 17 of 24
Project NYS Dam Inspection | Date 6-8-81
Subject Kirk Lake Dam | By [illegible]
Ch'k. by

Calculate Y-Y centroid of mass for location of dynamic mass forces

Find center of mass L_x in Y-Y direction for spillway section

Section B-B from pg 5

Total Mass 117.206 Kips

$M_{(3)} = 4 \times 6 \times 3 \times .165 = 11.88$

From Top 0-3' Mass (3.5 ... × .165) − M_1 − M_2 − M_3
= 29.7 − 7.92 − 1.98 − 11.88
= 7.92

3 ≤ Y ' Mass ((Y−3) × 15 × 4 × .165) − (4 × 6 × (Y−3) × .165)

Find ½ total mass = 117.206 / 2 = 58.603

58.603 = 7.92 + (Y−3)(9.9) − (Y−3)(5.96)

58.603 = 7.92 + 5.94(Y−3)

50.683 = 5.94(Y−3)

Y−3 = 8.53

X = 11.53' from Top of Sill

Section C-C

from pg 6 Total mass = 166.2 Kips from Side Wall to gate

from top 0-3' Mass (3 × 15 × 3.1 × .165) − M_1 − M_2 =
= 23.02 − 6.138 − 1.534 = 15.34

3−Y Y < 16 Mass (Y−3)(15)(3.1) × .165)

½ Total Mass = 83.1 Find Centroid −

83.1 = 15.34 + (Y−3) 7.67

67.76 = (Y−3) 7.67

8.83 = Y3

Y = 11.83' from top

TAMS

Job No. 1579-13 Sheet 18 of 24
Project N.K. [illegible] Date 6-8-81
Subject Kirk Cole Dam By [illegible]
Ch'k. by

Find Centroid of Remaining Mass as p. pg 7
Total mass is 754.155

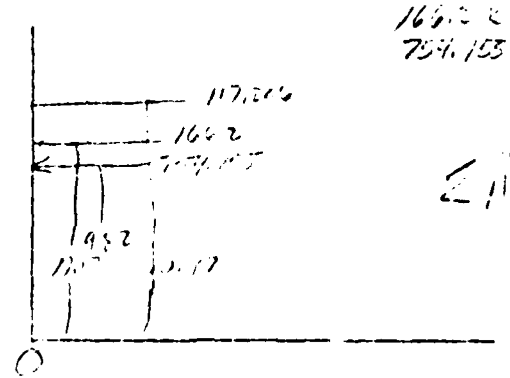
Mass (BY > 5.3 = [15 × 2(6.7) × .165] (Y) − 103.257 −

Pt of ½ mass =
377.077 = 33.165 Y − 103.257

480.334 = 33.165 Y
Y = 14.48' from top of wall

Resultant [illegible]
[illegible]

Mass	Mo
117.206	22 − 11.53 = 10.47'
169.2 k	22 − 11.83 = 10.17
754.155 k	24.3 − 14.45 = 9.82



ΣM_o = 7405.8 + 1699.2 + 12[illegible]
= 10,323.2 k ft

Total Mass = 1037.5 k

$\frac{\Sigma M_o}{T.M.} = \frac{10,323.2 \text{ kf}}{1037.5 \text{ k}} = 9.95'$

Location of Y-Y centroid is 9.95' above base at midpoint of [illegible]

TAMS

Job No. 1579-13 Sheet 19 of 24
Project 115 Dam Improvement Date 6-7-81
Subject Tuttle Creek Dam - Stability Analysis By [illegible]
Ch'k. by

Case II, Normal Loading Plus Earthquake

Zone 2 ⇒ 0.05 g

1) Hydrodynamic Load - 3' of Freewater

Zangers Method

for Vertical wall $\theta = 0$ $C = 0.73$

$P = 0.73 \times 0.05 \times 0.0624 \times 3.0 = .0068$

$P_T = \frac{1}{2}(.0068)\,3 = .010$ kips

$M = .010 \times .4 \times 3 = .012$ k-ft

2) Dynamic Load Soil Mass

$W_{s.c} = 125(\frac{1}{3})(17)^2(.75)(.05) = .677$ kips

Applied to wall at Resonance (Seed-Whitman 1970) $M = .677 \times \frac{17 \times 2}{5} = 7.68$ k-ft

[illegible] (inertia)

Reservoir Load 50.6 kips

for 0.05 g [illegible]

in Interia $50.6 \times .05 = 2.53$ kips

$M_a = 9.95'$ $M = 25.17$ k-ft

$\Sigma F_c = 3.20$ kips

$\Sigma M = 32.85$ k-ft

TAMS

Job No. 1579-03 | Sheet 20 of 24
Project [illegible] | Date [illegible]
Subject Kick Cat. [illegible] - Stability Analysis | By [illegible]
Ch'k. by

Analyses

CASE I Normal Loading

	Fv	FH	MR	Mo
Dead Load	50.6	—	449.3 kft	
Side Slope	—	-7.31	59.2	
Hydrostatic load	-11.3	11.23k	—	185.2 kft
Earth forces	—	5.1k	—	33.0 kft
	39.3	9.05	508.5	218.2

$\Sigma M = 508.5 - 218.2 = 290.3$ kft

$\bar{e} = \frac{17}{2} - \frac{290.3}{39.3} = 1.11'$

is $\frac{17}{6} - 1.11 \geq 0$ (1.72 ok) Resultant within middle 1/3 - OK

Sliding Stability [illegible] [illegible] assume C at base 200 psf

$F.S. = \frac{Fv \tan\phi + C A}{F_H}$

$F.S. = \frac{39.3 \cdot [illegible]}{9.05} = 3.41$ OK

TAMS

Job No. 1579-13 | Sheet 21 of 24

Project [illegible] | Date 6-10-81

Subject [illegible] | By JFW

Ch'k. by

Case II Ice loading w/ Normal water [illegible]

	Fv	FH	MR	MO
Dead Load	50.6		449.3	—
Side Shear	—	-7.31	59.2	—
Hydrostatic Load	-11.3	11.26	—	185.2
Ice load	—	5.0	—	92.5
Earth [illegible]	—	5.1	—	33.0
	39.3	14.[illegible]	508.5	310.7

$\Sigma M = 508.5 - 310.7 = 197.8$ kft

$\bar{e} = \frac{17}{2} - \frac{197.8}{39.3} = 3.46'$

is $\frac{17}{6} - 3.46 \geq 0$ (-.63) no   [illegible] middle 1/3

Sliding Stability ϕ' 35° C' = 200 psf [illegible]

$F.S. = \frac{39.3 \ldots + 17(\ldots)}{14.\ldots} = \underline{2.20}$

[illegible] sliding [illegible] stated acceptable criteria

TAMS

Job No. 1579-13 Sheet 22 of 24

Project NYS Dam Inspection Date [illegible]

Subject Kirk Lake Dam - Stability Analysis By [illegible]

Ch'k. by

Case III ½ PMF - no ice.

	F_V	F_H	M_R	M_O
Dam load	50.6		449.3	
Side Slope	—	-7.31	59.2	
Hydrostatic load	-13.6	19.67	—	293.58
[illegible]	—	5.10	—	33.0
	37.0	17.46	508.5	326.58

$\Sigma M = 508.5 - 326.58 = 181.92$ k-ft

$\bar{e} = \frac{17}{2} - \frac{181.92}{37.0} = 3.58'$

is $\frac{17}{6}$ 3.58 > ? (2.83) no) NOT Acceptable - Resultant not within middle 1/3 of base

Sliding Stability assume ϕ = 35 c' = 200 psf

$$F.S. = \frac{37.0 (\tan 35) + 17(.2)}{17.46} = 1.68 < 3$$

Does not meet criteria

TAMS

Job No. 1577.13 | Sheet 23 of 24
Project NYS Dam Inspection | Date [illegible]
Subject Kuck Lake Dam - Foundation Analysis | By [illegible]
Ch'k. by

Case IV PMF

	F_v	F_H	M_R	M_O
Dam Load	50.6	—	449.3	
Sed. Shear		-7.31	57.2	
Hydrostatic Load	-14.8	22.50		336.3
Earth Force	—	5.10	—	32.0
	35.8	20.29	508.5	368.3

$\Sigma M = 508.5 - 368.3 = 140.2$ k ft

$\bar{x} = \frac{17}{2} - \frac{140.2}{35.8} = 4.58$

is $\frac{17}{6} - 4.58 \geq 0$ (-1.75 no) [illegible] middle 1/3 of [illegible]

[illegible]

Sliding Stability $\phi = 35°$ $c = 200$ psf at base

$F.S. = \frac{35.8 \tan [illegible]}{20.29} = 1.40 < 3$

Does not meet criteria

Case V - Dynamic Loading

	F_v	F_H	M_R	M_O
Dam Load	50.6	—	449.3	—
Sed. Shear	—	-7.31	57.2	—
Hydrostatic Load	-11.3	11.26	—	185.2
Earth Force	—	5.10	—	33.0
Dynamic Load	—	3.20		32.85
Hydrodynamic Load	—	.01		.01
	39.3	12.26	508.5	251.06

$\Sigma M = 508.5 - 251.06 = 257.44$

$\bar{x} = \frac{17}{2} - \frac{257.4}{39.3} = 1.95$

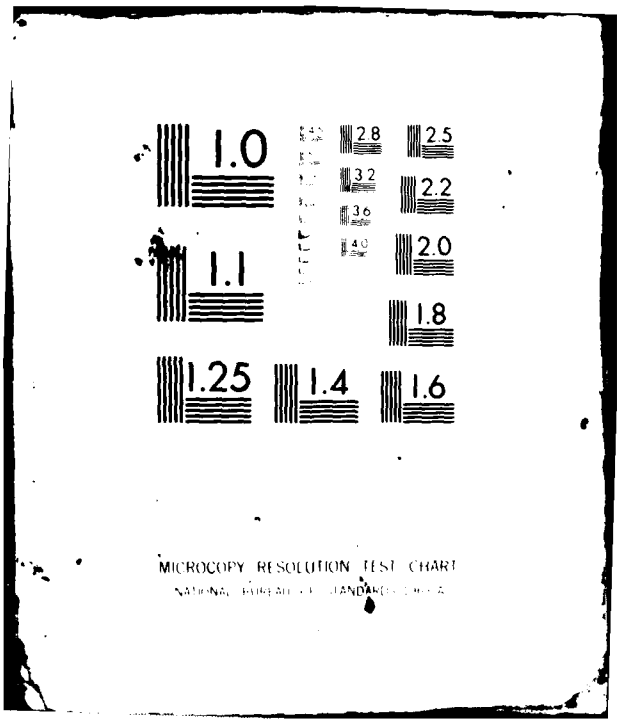
is $\frac{17}{6} - 1.95 \geq 0$ (2.30 [illegible]) [illegible]

Sliding stability F.S. = [illegible]

AD-A107 408 TIPPETTS-ABBETT-MCCARTHY-STRATTON NEW YORK F/G 13/13
NATIONAL DAM SAFETY PROGRAM. KIRK LAKE DAM (INVENTORY NUMBER N.--ETC(U)
AUG 81 E O'BRIEN DACW51-81-C-0008

UNCLASSIFIED NL

END
DATE FILMED
12-81
DTIC


1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART

TAMS

Job No. 1579-03 Sheet 24 of 24

Project Lily Dam Improvement Date 6-10-81

Subject Kirk Lake Dam - Stability Analysis By JFW

Ch'k. by

Summary

Case	Rock Head Location: Eccentricity	Accept.	Stability: Sliding F.S.	Accept.
I	1.11'	yes	3.41 > 3	yes
II	3.46'	NO	2.20 < 3	NO
III	3.58'	NO	1.68 < 3	NO
IV	4.58'	NO	1.40 < 3	NO
V	2.30'	yes	2.52 > 1.5	yes

REFERENCES

APPENDIX F

REFERENCES

1. "Flood Hydrograph Package (HEC-1) Users Manual for Dam Safety Investigations", U. S. Army Corps of Engineers, Hydrologic Engineering Center, September 1979.

2. "Seasonal Variation of the Probable Maximum Precipitation, East of the 105th Meridian for Areas from 10 to 1,000 Square Miles, and Durations of 6, 12, 24 and 48 Hours", Hydrometeorological Report No. 33. Weather Bureau, U.S. Department of Commerce, April 1956.

3. "Recommended Guidelines for Safety Inspection of Dams", Department of the Army, Office of the Chief of Engineers, Appendix B.

4. The University of the State of New York, The State Education Department State Museum and Science Service Geological Survey - MAP and Chart Serves No. 5, Geologic MAP of New York 1961, Lower Hudson Sheet.

OTHER DATA

APPENDIX G

THE CITY OF NEW YORK
DEPARTMENT OF
WATER SUPPLY, GAS AND ELECTRICITY

BUREAU OF WATER SUPPLY
MUNICIPAL BUILDING
NEW YORK

Structures impounding water

February 28,1925.

Mr. Roy G. Finch,
State Engineer,
Albany, New York.

Dear Sir:

Your favor of the 19th inst. acknowledging receipt of our letter of February 13,1925 with accompanying reports on fourteen dams in the Croton watershed, to hand.

I am transmitting herewith reports on six distributing reservoirs (Croton and Long Island supplies) within the limits of the City of New York, one distributing reservoir (Hill View Catskill supply) just north of the city limits and one storage reservoir (Hempstead) on Long Island.

Your assumption that the Muscoot dam (your number 406) is just below the point where the Muscoot river originally flowed into the Croton River, is correct.

46 L H

I note your reference to the dam on the headwaters of the Muscoot river one mile from the village of Mahopac and 1/4 mile above the NYC RR bridge. This dam is undoubtedly the one at the outlet of Kirk Lake and is located one half mile above the village of Mahopac Falls. It is owned by the City of New York and was originally constructed in 1870-71; it was reconstructed in 1881. Length of dam 160 feet; 36" inlet pipe 19 feet below High water. There are no plans of this dam in existence so far as we have know.

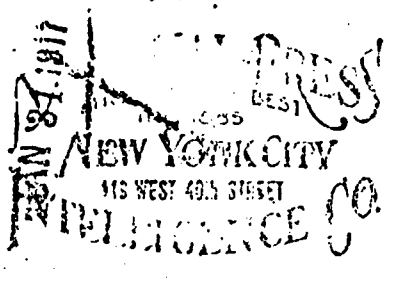
Very truly yours,

Chief Engineer

Enc. 8 reports

54 L H
102 "
135 "
136 "
160 "

481 L H



CARMEL, N. Y., COURIER (662)

Friday, January 26, 1917.

so fast the Presbyterian ... Temperance, in whose interest he was working had transferred a number of their men, to the eastern states.

A LEAK IN KIRK-LAKE DAM

A small leak was discovered in the dam at Kirk Lake on last Friday evening which required about three hours work to repair it. It was fortunate that the leak was discovered in time or perhaps the dam might have given away causing much trouble.

THIRD ANNUAL RECEPTION

The third annual reception and ball

37-15-4 (7/76)

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DAM INSPECTION REPORT
(By Visual Inspection)

Dam Number	River Basin	Town	County	Hazard Class*	Date & Inspector
481	L. Hudson	Cornwall	Putnam	B - C	10/26/76 KMH

Type of Construction

- ☐ Earth w/concrete spillway
- ☐ Earth w/drop inlet pipe
- ☑ Earth w/stone ~~or pipe~~ spillway
- ☐ Concrete
- ☐ Stone
- ☐ Timber

Use

- ☐ Water Supply
- ☐ Power
- ☑ Recreation
- ☐ Fish and Wildlife
- ☐ Farm Pond
- ☐ No Apparent Use-Abandoned

Estimated Impoundment Size

- ☐ 1-5 acres
- ☐ 5-10 acres
- ☑ Over 10 acres 120 (±) ac.

365 MG

Estimated Height of Dam above Streambed

- ☐ Under 10 feet
- ☐ 10-25 feet
- ☑ Over 25 feet 30'

Condition of Spillway

- ☑ Service satisfactory
- ☐ In need of repair or maintenance
- ☐ Auxiliary satisfactory
- ☐ In need of repair or maintenance

Explain: _____

Condition of Non-Overflow Section

- ☑ Satisfactory
- ☐ In need of repair or maintenance Explain: _____

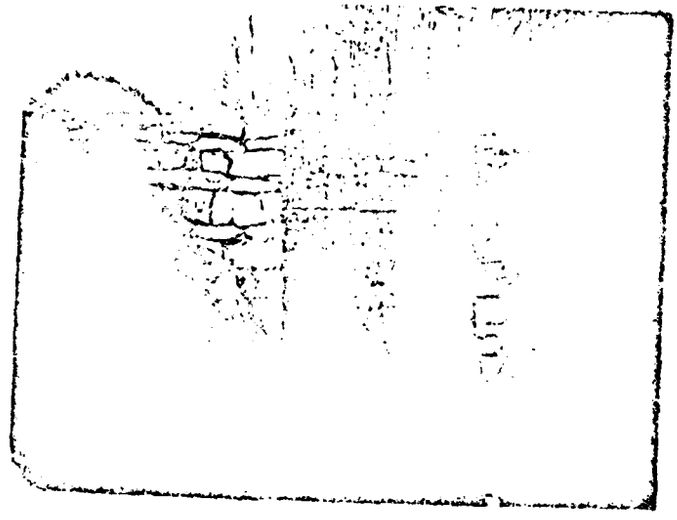
Condition of Mechanical Equipment

- ☑ Satisfactory
- ☐ In need of repair or maintenance Explain: _____

Evaluation (From Visual Inspection)

- ☑ No defects observed beyond normal maintenance
- ☐ Repairs required beyond normal maintenance

*Explain Hazard Class, if Necessary _____



Form 1W51 6-16-16 2400 (16-15784)

(NOTICE: After filling out one of these forms as completely as possible for each dam in your district, return it at once to the Conservation Commission, Albany.)

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

DAM REPORT

July 27th, 1915
(Date)

CONSERVATION COMMISSION,

DIVISION OF INLAND WATERS.

GENTLEMEN:

I have the honor to make the following report in relation to the structure known as the Kirk Lake Dam.

This dam is situated upon the Headwaters of Muscoot River (Give name of stream) in the Town of Carmel, Putnam County, about 1 mile (State distance) from the Village ~~of~~ of Lake Mahopac. The distance down (Up or down) stream from the dam, to the N.Y. Central R.R. Bridge (Give name of nearest important stream or of a lake) is about 1/4 mile (State distance).

The dam is now owned by New York City (Give name of mill) and was built in or about the year 1872, and was extensively repaired or reconstructed during the year ——.

As it now stands, the spillway portion of this dam is built of Cut Stone (State whether masonry, concrete or timber) and the other portions are built of Cut Stone Earth fill (State whether masonry, concrete or timber).

As nearly as I can learn, the character of the foundation bed under the spillway portion of the dam is Rock and under the remaining portions such foundation bed is Rock & Gravel.

213 - C F

The total length of this dam is 150 feet. The spillway or waste-weir portion, is about 20 feet long, and the crest of the spillway is about 4 feet below the top of the dam.

The number, size and location of discharge pipes, waste pipes or gates which may be used for drawing off the water from behind the dam, are as follows: One 36" discharge pipe directly under Spillway

State briefly, in the space below, whether, in your judgment, this dam is in good condition, or bad condition, describing particularly any leaks or cracks which you may have observed.)

This dam is in excellent condition and showed it to go out the water moved pretty nearly take care of itself without serious damage to surrounding property because there seems to be scarcely any buildings in its valley and a special artificial sluiceway through the fields has been built.

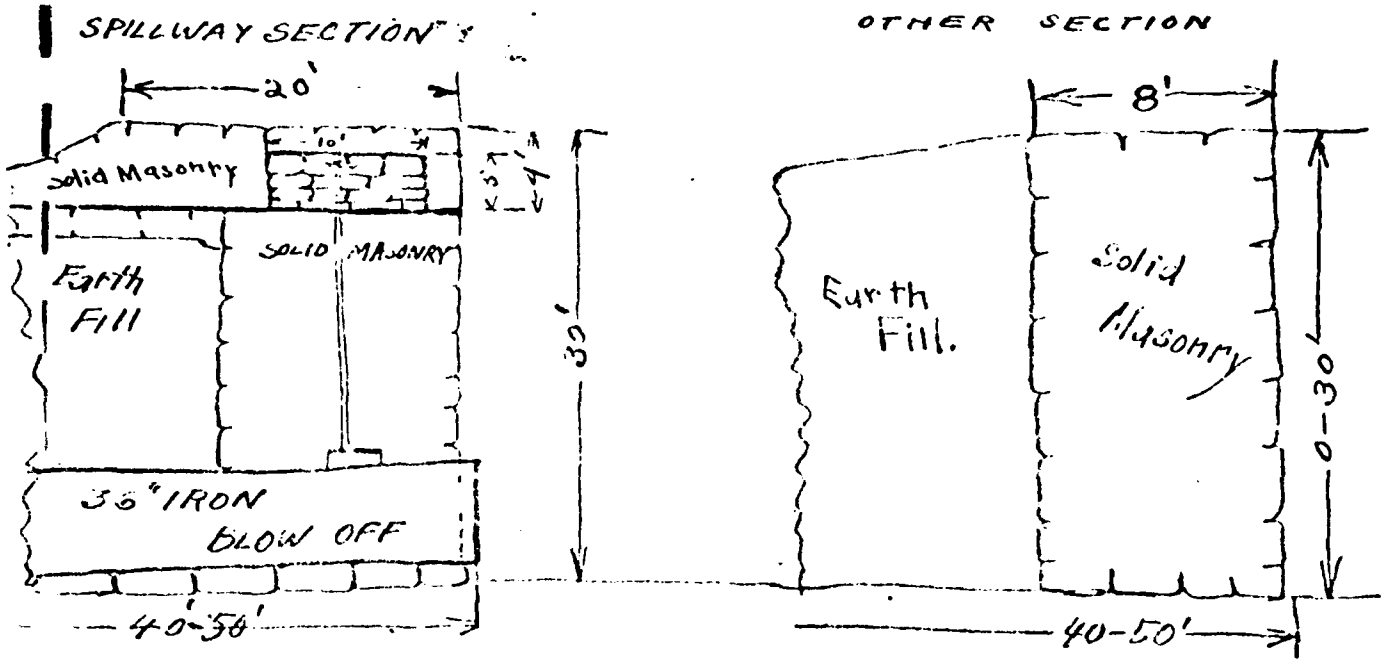
Reported by L D Seymour
(Signature)

(Address—Street and number, P. O. Box or R. F. D. route)

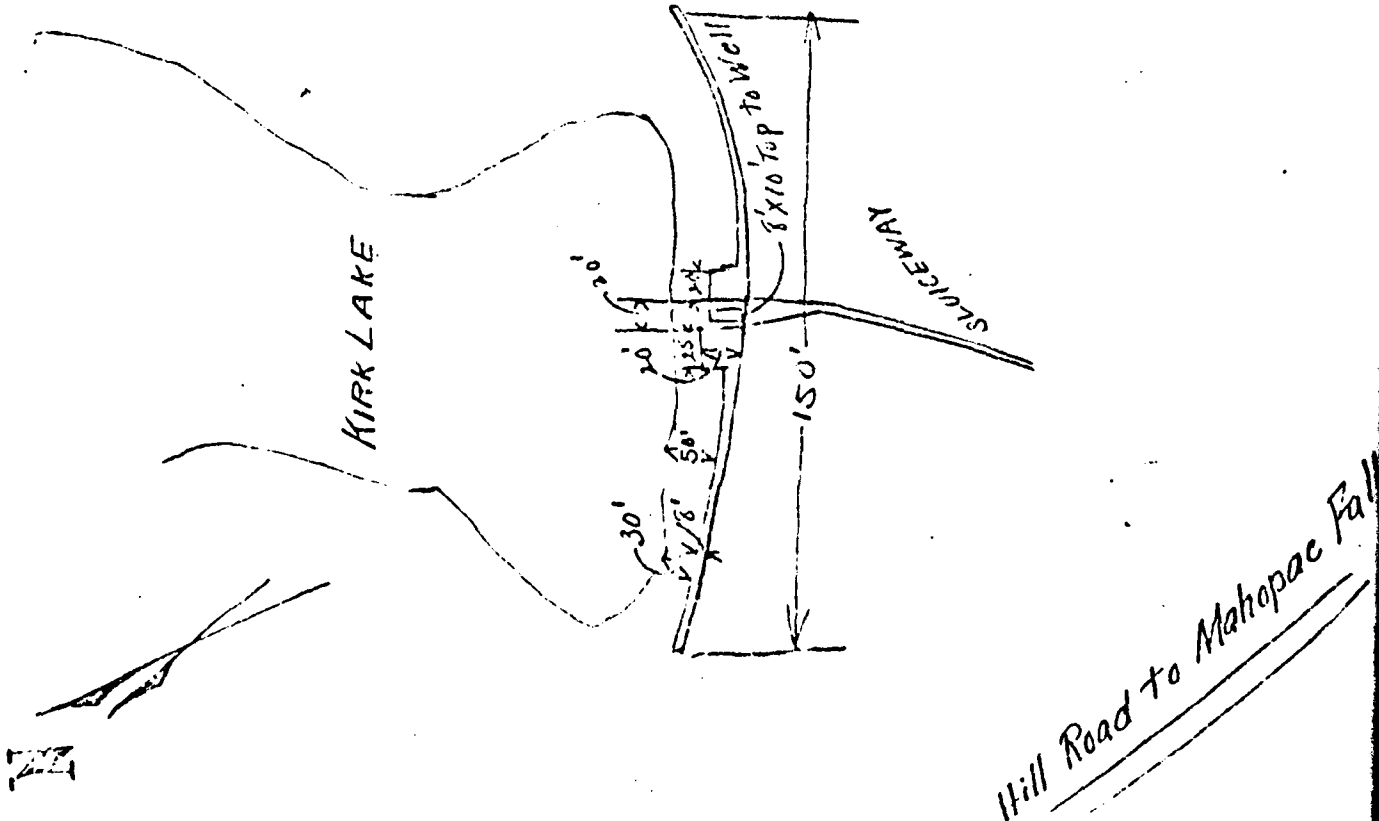
Wolcott N.Y.
(Name of place)

(SEE OTHER SIDE)

(In the space below, make one sketch showing the form and dimensions of a cross section through the spillway or waste-weir of this dam, and a second sketch showing the same information for a cross section through the other portion of the dam. Show particularly the greatest height of the dam above the stream bed, its thickness at the top, and thickness at the bottom, as nearly as you can learn.)



(In the space below, make a third sketch showing the general plan of the dam, and its approximate position in relation to buildings or other conspicuous objects in the vicinity.



END

DATE
FILMED

12-81

DTIC